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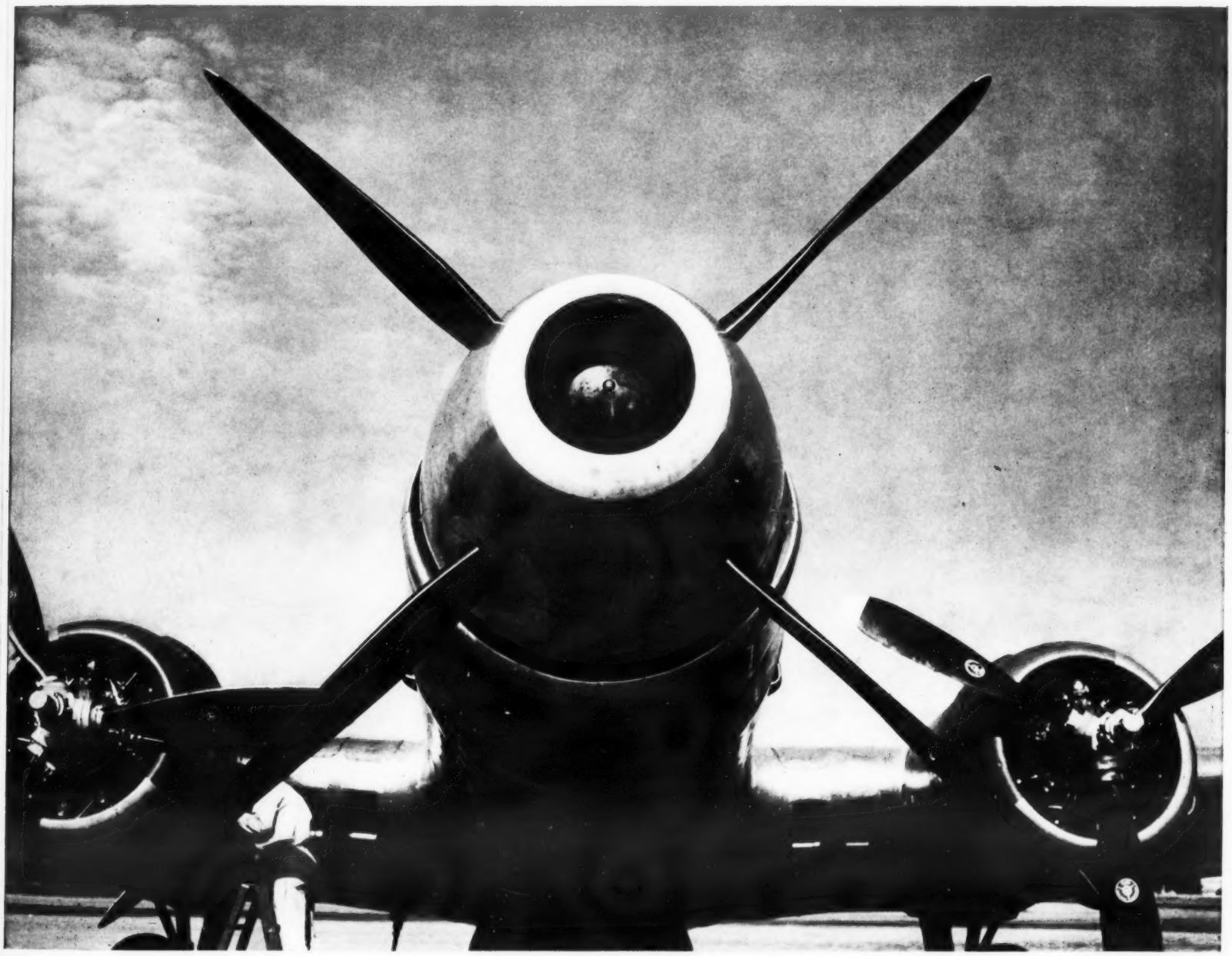
Review of World Aviation



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A Merry Christmas all the same !

Birds and Planets — Flying Flowers — Helicopters in the Alps

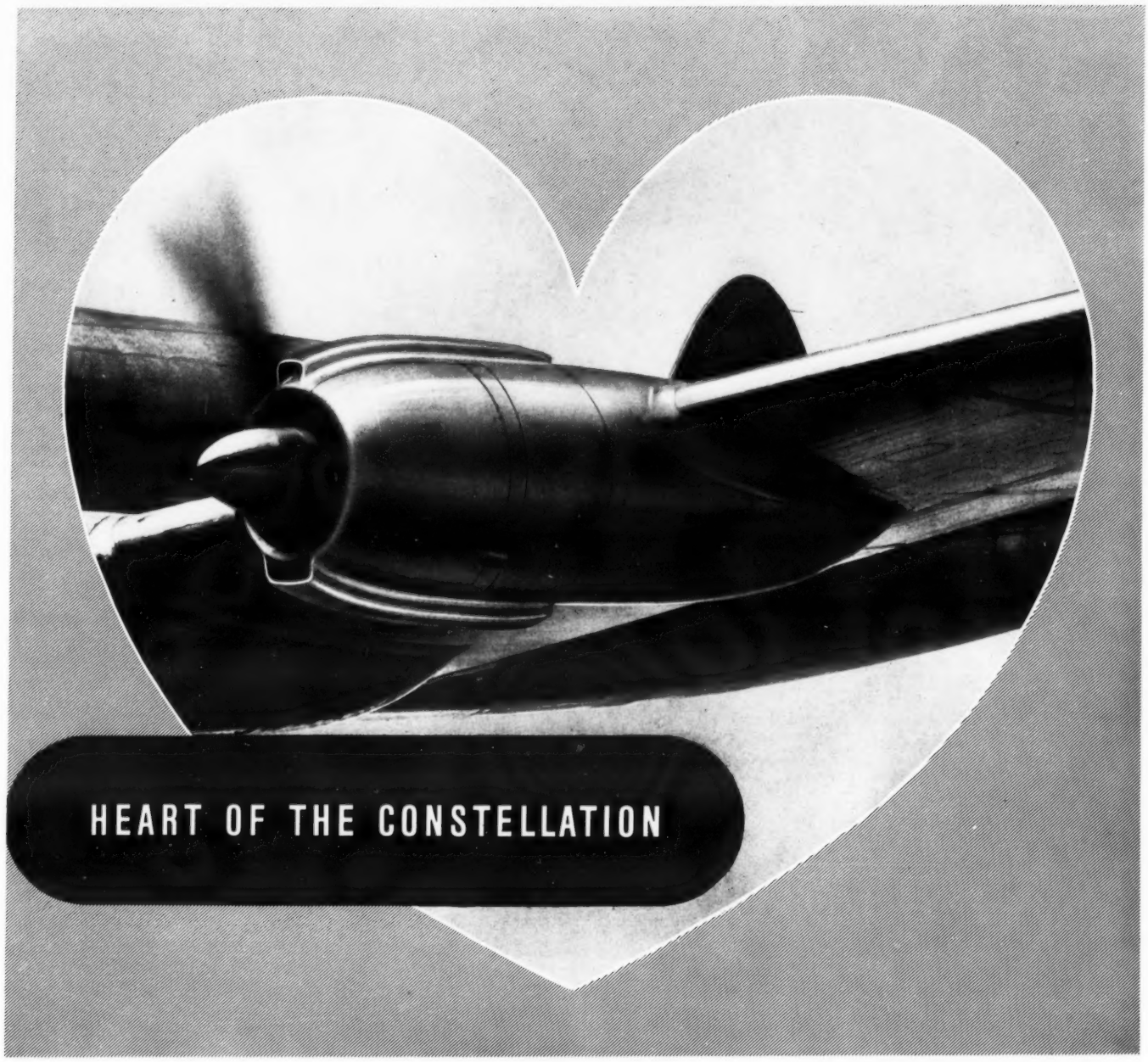
W. Just : Compensating Torque in Helicopters

Breda-Zappata BZ. 308 — Russian Aircraft for Export

The Reason for Larger and Faster Airliners

Huetter : Advancing Sailplanes

VOLUME III No 12 DECEMBER, 1948



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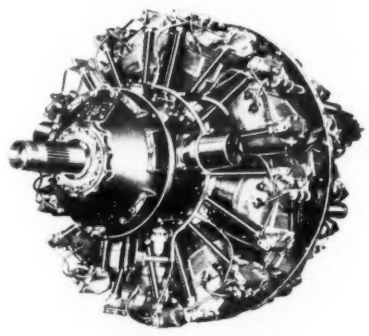

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Wright "Typhoon" propeller-turbine in the nose of a Boeing B-17. (cf. page 697).

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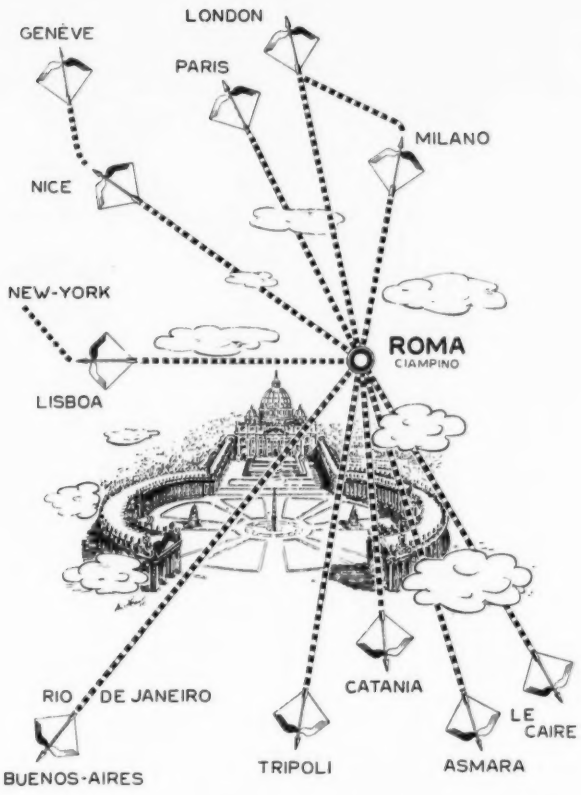

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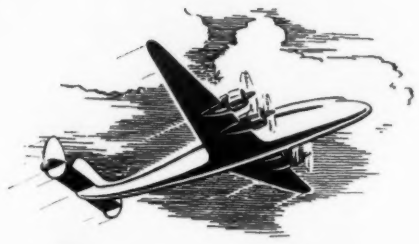

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A Merry Christmas
and a Happy New Year
to all our Readers
and Friends

PUBLISHERS AND EDITORS OF INTERAVIA

OVERHAULING A NORTH-ATLANTIC AIRLINER : After every 70 hours, thus four trips at the most, each "Constellation" of Air France is subjected to a thorough overhaul.

A Merry Christmas all the same!

Once again I had the pleasure of spending a few days in the metropolis of our time, New York.

On October 19th I boarded a Lockheed "Constellation" of Air France, which left New York's Idlewild airport at 4.30 p.m. local time. Passengers were informed over the loudspeaker that we would fly at about 20,000 feet non-stop to Paris-Orly, and take only twelve and a half hours.

My companion for the journey was an American insurance broker who was flying on to Saigon from Paris. Our conversation veered from the Old to the New World, and we completely forgot that we were crossing the Atlantic. At about 7.30 the traditionally excellent Air France dinner was served. Later on, the berths were made up and everyone retired for the night as if in a luxury ocean-going liner or a hotel.

Sleep came immediately, and before I knew it, the air hostess was standing before me : "Good morning, sir. Would you prefer to have breakfast in bed, or to get up ? We are due to land at Orly in an hour."

The flight over the Herring Pond was ended. What had been a great journey to our fathers, and an adventure to our forefathers, had shrunk to nothing. Era of science, of engines, aircraft, radio and atomic energy... There are no longer any distances... INDIVISIBLE WORLD !

*

By taxi through the autumn-clad streets of Paris ; hotel, lunch, and back to work.

The memories of my last day in New York were still fresh in my mind. I thought back on the unimaginable hustle and bustle between those gigantic pyramids of steel and concrete, a symbol of the New World, the new technical civilisation. Simultaneously I drank in the charm of that culture which scarcely any other city in the world radiates so strongly as the capital of France. Somehow I felt happy to be born in this era, despite the terrible setbacks it occasionally presents.

Towards the evening I returned to my hotel, where I found an announcement of a person-to-person telephone call from Amsterdam. A friend of mine, representing an American firm in Europe, was flying back to California for about three weeks. He wanted to say goodbye. I never thought that it was to be goodbye for always... A few hours later his name was on the list of victims of the air crash at Prestwick, Scotland.

My former happiness was turned into bitterness.

*

Back at my desk again, I glance through my notes, and read the letters which arrived during my absence. The events which occurred while I was away, mix with my experiences in New York. A kaleidoscopic film passes through my mind.

The questions people asked me in America. What is the opinion in Europe on the international situation ? What is going on in France ? Is it true that Communism is getting dangerous there ? What do the Swiss say to it all ?

What could I reply ? We of the Old World, do we not ask ourselves, every day and every hour, the same questions as the man-in-the-street of New York ? Are we not concerned with the same worries and hopes as probably the Russians, the French, the Italians, the Germans ... indeed every inhabitant of this world ? Why do these worries exist ?

I spoke with many people in New York. I met pessimists and optimists, and could not really contradict a single one of them, or tell them anything new. The impression I gained in America, how it struck me then as a European among Americans and still strikes me today, is contained in the paragraphs which follow.

Do not be misled into thinking that the Americans are solely occupied with the presidential election campaigns, which are to be decided on November 2nd. By the time these lines are in print, the new President will have been elected. But whether his name be Harry S. Truman or Thomas E. Dewey, this event will not necessarily be followed by radical changes in foreign policy. America has chosen her way ahead and has already begun to advance along it. She is world power No. 1, and she is conscious of her tasks and duties. America considers herself to be a great power, but not an empire. She wants her desires to be heeded, but she is also willing to take into account the desires of other nations. Is it not clear that here already there lies a difference from the concepts of earlier decades, concepts of great powers to which the Old World gave birth ?

It is nonsense to assume or maintain that the American is not up to the enormous tasks set before him by recent political developments and that he is not yet sufficiently grown up. He is no longer a boy, but a young man whom the hard school of two world wars and two victories has readied for his new duties. And do not tell me the old story about his having no culture. What, indeed, is culture ? It is something permanent and down to earth ; it is the expression of a nation's way of living. And just as there has been Chinese, Greek, Roman, Italian, French, German, English or Spanish culture, there is

AIR-FRANCE DINNER : Hors d'œuvres and champagne.

today a typical form of American culture. Just as any other, it traces back to the pioneering days, is built upon these, and continues to take shape.

*

One expression of American culture is American technical science. Men like Edison and Ford began it, and today the symbols of this culture are such names as General Motors, General Electric, Radio Corporation of America, United Aircraft, Curtiss-Wright, Douglas, Lockheed, and so forth. The cocktail, Max Factor's beauty products, drug stores and shoe-shine boys are not expressions of this culture, but merely concomitant phenomena. They are the natural consequences of prosperity which has heaped up at a meteoric rate in the course of about thirty years. And behind these external aspects still stands the American farmer, miner, the man at the workshop bench and the oil drill—the real America.

And as an external sign of this culture we have the fact that America is not only a world power as such, but—and this may be decisive in many ways during the next few years—is rapidly becoming an air power that will be absolutely unbeatable, indeed not even approachable.

*

Though I travelled on board a French airliner, and the crew was European and the service was European, the aircraft, engines, instruments, and the entire equipment down to the serving trays, was "made in U.S.A." Perhaps it was precisely this mixture, this cross between American technical science and European customs, that lent the unmistakable charm to my trip on board a "Constellation" flying under the French flag. I have found out that many Americans think the same as I do. And in this lies a hope.

*

What is the American's attitude to North Atlantic air transport ?

Before the war, when he travelled to or from Europe, he had the choice—depending on the degree of comfort to which he was used—of travelling either in a British, French, Italian, Dutch or German ship. American liners were second class and have remained so.

The Americans have learned a lesson from this situation. They no longer desire to play the second-class rôle on the North Atlantic which they played in prewar days. It is not that they regard the North Atlantic—as did the Romans and later Mussolini the Mediterranean—as their *mare nostrum*, a purely American affair. They merely draw the logical consequences from certain facts : we are not an empire, we do not consider ourselves the taskmaster of other nations, but we do not wish to be forced out of honestly-gained positions by other nations. Since we had to cross the air space over the North Atlantic day and night during the last war, we feel that we have a certain right to it.

Americans are defending this right, and do not intend relinquishing their North Atlantic privileges for a long time to come. They have fought for these privileges, they are keeping equipped in order to defend them, and anyone else deciding to fly through the North Atlantic air space must just take all this into account.

*

And now I find in a leading Swiss newspaper an article by an engineer who makes a "Proposal for placing the North Atlantic airline services on a healthier basis." I deem it necessary to go into this article because many of the author's statements seem to stem from erroneous viewpoints, which may also exist in the minds of other people. Like many Europeans, he looks at the complex of North Atlantic air traffic and the problem of its adjustment, through the eyes of a European only, even though he may he acquainted with American conditions. Perhaps he did not sufficiently examine these conditions, or is unaware of the latest developments.

He begins with the problems of how the "losses of millions incurred by the major airline companies" can be eliminated, how the "huge capital sums invested in world civil aviation can be made to produce dividends," and "airline companies made to work like normal business

NEW YORK : The Statue of Liberty, and a view of the skyscrapers.

concerns." He sees the cancerous affliction in the form of the "top-heavy organisation, the paper war, the no-payload flights, certain wrong investments, and particularly in the high administrative costs." He calculates the latter costs as amounting to "50 to 200 per cent. of the direct costs," these being constituted by "effective expenses for fuel, crew wages, aircraft maintenance, service to passengers."

He therefore wants to change the ratio between administrative and operating costs. What does he propose ?

As regards competition in the technical domain, he sees no success as long as jet-propulsion has not found its way into civil air transport. And the time which one carrier can gain over another by using a new type of piston-engined airliner is, in his opinion, unimportant.

Nor does he believe in competing by introducing non-stop flights, thus without intermediate landings in Ireland and Newfoundland, or Scotland, Iceland, Greenland and the Azores. He bases this idea on the explanation that each of these intermediate landings requires one and a half hours, so that the usual two stops prolong a flight by three hours, to which must be added one hour for deviations from the direct, great circle route. The four hours thus gained by flying non-stop, in the author's opinion, do not offset the commercial loss incurred by having to increase the fuel supply for an approximately 4,000-mile range required by a non-stop flight, as opposed to the smaller supply necessary for the range of only 1,960 miles between Shannon and Gander on a flight with intermediate landings.

All this he wishes to leave as it is, and proposes a cure-all for the illnesses in North Atlantic air transport, which may read all right to the layman, but is neither new nor realisable at the present time. He suggests the establishment of a supranational "North Atlantic Convention," a sort of pooling of expenses and revenues ; flights would be carried out under the national flags but with aircraft types as much

PARIS : Looking towards the Arc de Triomphe and Place de l'Etoile.

NORTH-ATLANTIC FLIGHT WITH INTERMEDIATE LANDINGS: Airliner with forty-four passengers.

as possible the same ; accompanied by a trimming of the individual organisations of carriers or countries. He calculates that a hundred round trips are made each week, whereby the three U.S. carriers flying the North Atlantic—Pan American Airways American Overseas Airlines and Trans World Airline—take the lion share, having transported 73 per cent. of the 194,236 passengers carried in 1947. He maintains that the other seven trans-Atlantic operators—B.O.A.C., Air France, K.L.M., Sabena, S.A.S., Swissair, and Trans-Canada Airlines—cannot see their way ahead in view of this traffic distribution, but should draw the logical conclusions from this situation : a trimming of their expensive organisations abroad for administration, ticket-selling, maintenance, and so on ; a transfer of each organisation to the national airline set-up of the country in question, which would have to act as an impartial custodian of the interests of each participant. In brief, he gives Scandinavian Airlines System as an example, and proposes establishing a kind of "United Nations of the Air" for all companies or nations flying the North Atlantic.

As has already been said, this concept is neither new nor realisable.

It is not realisable, first of all because of the privileged position of the U.S.A., discussed earlier in this article. The Americans have no intention whatever of entrusting their interests to other nations, even though these may give evidence of very good will. Moreover, there exists in the U.S.A. anti-trust legislation forbidding pool operations of this nature for American companies, not to speak of a pool between American and European companies.

To this comes the fact that the competition over the North Atlantic, from the American standpoint, is at present not only international, but also a national affair. The U.S. Government is aware of this and favours it. The leader is Pan American Airways, American Overseas Airlines is weaker, and Trans World Airline weaker still. It is an open secret that Juan T. Trippe, President of P.A.A., is toying with the idea—and perhaps not entirely without prospects of succeeding—of fusing T.W.A. with his own company. At some future date, therefore, it is possible that, instead of three, only two, relatively strong U.S. companies will participate in the battle. This battle has to be fought out.

And the Europeans ? Do you think that a Dutch ticket salesman, with the best will in the world and absolutely convinced by the plan, would sell a ticket for a Swedish, French or Swiss carrier just as willingly as he would for a Dutch company ? Do you not believe that a British, Dutch, or French passenger would prefer to travel by one of his national airlines ? Would you be in favour of a supranational organization which forbids him to do this ? The plan would not be compatible with shipping organisations, nor are such customs found in railroad transport. Even the railway traveller likes to choose the coach which suits him best. Or is this not so ?

We shall not mention the currency difficulties which would confront such a plan—perhaps these will be mastered some day—nor shall we speak of the language, service and other setbacks facing the idea. We shall just reject the plan because it is Utopian and might prove misleading to the man-in-the-street.

Competition over the North Atlantic exists and will continue to exist. The leaders at present are the Americans, and they are desirous of maintaining this competition.

Meanwhile, it is our opinion that the Europeans should participate in this competition—that is, if they do not wish to divest themselves of their last vestiges of world power. Nor will they be the losers in the battle, providing they conduct it with the means they now have at their disposal : well-trained crews, perfect service, and good aircraft—the latter American. But on board these aircraft there must be a whiff of that old Europe for which we are fighting today, and which, down inside him, every Yankee—who after all originated from Europe —loves. Why, otherwise, should he fly to Europe ? It is hard to do business here, and there is less to eat.

We tend much more to believe that non-stop flights by European carriers, with sleeper aircraft, perfect service and proven crews, are an enormous attraction, even for the Americans. The time has come for air carriers to provide different classes of accommodation, as on ships.

NORTH-ATLANTIC NON-STOP FLIGHT : Sleeper airliner with twenty-two berths. Note the berths still folded up against the roof.

LOWER BERTH accommodation in a sleeper airliner.

AT THE YALTA CONFERENCE TABLE: On the left can be seen Marshal Stalin, then Roosevelt and, with the inevitable cigar, Winston Churchill. The Allies strengthened their decision to "maintain in peacetime the co-operation achieved in war, and defend the principles of the Atlantic Charter."

"EVERYBODY WAS IN A MOOD OF LOFTY EXALTATION": Roosevelt, Molotov and a Russian general... three friends.

And luxury airliners operated by the French and Dutch, perhaps later by the British, Scandinavians, Swiss and Belgians, would surely be able to inherit the tradition of the "Queen Elizabeth," "Normandie" and "Bremen."

These are our thoughts in connection with North Atlantic air transport.

*

Back in Europe again and learning at the same time as millions of other newspaper readers of the Soviet Union's 28th veto, what are our views on the future ?—with the Berlin blockade, the Iron Curtain, and many seemingly shattered hopes staring us in the face.

On the day of my departure a friend presented me with a book which, at that time, had not reached the market. It was his wish that I should bring the first copy to Europe of a publication which we are now finding reviewed in various sections of the press : "Roosevelt and Hopkins : An Intimate History," by Robert E. Sherwood. *

A playwright whose works have thrice won the coveted Pulitzer Prize (among others, he wrote the screen play for the film : "The Best Years of our Lives") and formerly overseas chief of the Office of War Information, Robert E. Sherwood is the first writer to take us behind the scenes of American war politics and clarify, for instance, the significant course of the Russo-Anglo-American conference at Yalta. After the death of Harry L. Hopkins—"Roosevelt's eyes, ears and legs, the selfless instrument of Roosevelt's will"—his widow, Mrs. Louise Hopkins, asked Sherwood to go into her husband's papers and collect these memoirs into a book. Before starting it, Sherwood interviewed and correspondended with dozens of leading personalities, with Churchill, Marshall, Dr. Vannevar Bush, many writers and columnists, politicians, generals, admirals, members of the Roosevelt family, and many others. And then he took up his pen to write 979 fascinating pages, with a profound introduction and a voluminous packet of notes at the end.

Here are a few fragments from his report on the Yalta Conference, taken from Hopkins' memoirs.

Roosevelt, Churchill and their staffs arrived at Yalta on February 3rd, 1945 ; Stalin, Molotov and their advisers arrived early next morning. When the Americans and British remarked on the destruction they had seen in the Crimea, Stalin told them that it was not comparable with that in the Ukraine.

Roosevelt and Churchill were in favour of a four-zone occupation of Germany, the fourth zone being for the French. Stalin and Molotov were not impressed by France's contribution to the winning of the war. At that time already, Molotov was frequently represented by the present U.N.O. delegate, Vishinski. Ill health had prevented General Arnold from coming to Yalta, and the U.S. Army Air Forces was represented by General Laurence S. Kuter, now chief of Air Transport Command. —Oddly, all this appears quite topical even today.

Charles E. Bohlen, of the U.S. State Department, stated that "very good humour" prevailed throughout the Conference, but admitted that he nevertheless had a conversation on the side with Vishinski, which sounded "mildly caustic." When he expressed the opinion that the American people were unlikely to approve of any denial of the small nations' rights, Vishinski replied that the American people "should learn to obey their leaders."

At one of the luncheon meetings, when many toasts were proposed, Molotov made it clear that his Government expected reparations in kind from Germany and hoped that the U.S.A. would grant Russia long-term credits. Stettinius replied that he was willing to discuss these matters at any time.

A few pages further on : Already at Yalta the Soviets began establishing their veto power in the U.N. Assembly, requesting two additional votes for the Ukraine and Byelorussia. The Americans were decidedly uneasy about this, for, in principle, they had the same right to demand fourty-eight votes for the United States. But the war was drawing to a close, and their was no desire to disturb the peaceful atmosphere prevailing at Yalta. According to Hopkins, Churchill was strongly in favour of the two extra votes for Russia—eventually because "he was influenced by British imperial considerations."

The toasts which were proposed are a story in themselves. Marshal Stalin began by proposing a toast to Churchill, "the bravest governmental figure in the world." Churchill replied by toasting Stalin, "the mighty leader of a mighty country, which had taken the full shock of the German war machine, had broken its back . . ." And then followed toasts proposed by and to Roosevelt, Hopkins, Molotov, and the whole crowd.

Everybody was in a mood of lofty exaltation.

Things like that happened in February, 1945. The Allies had by joint effort brought to victory a fight which had originally appeared hopeless. Their leaders sat round the same table, elatedly discussing the forthcoming triumph, hardly a word of anger crossing their lips.

There crops up the obvious question of why cannot the same people get together again and work for peace.

I brought over to Europe the first copy of "Roosevelt and Hopkins." For me it represents a Christmas gift from an American friend. If many people read it, if it is translated into several languages . . . it perhaps represents a 1948 Christmas hope.

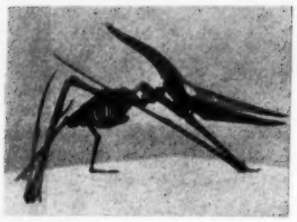
I wish that it were so.

E. E. H.

* Harper & Brothers, New York, 1948.

Men, Birds and Planets

NATURE STUDY AND AVIATION HISTORY



These creatures flew over the earth 200 million years ago. A flying Saurian known as the Pteranodon had a wing spread of about 20 feet. The picture shows a model of the Pteranodon prepared by M. Reichel, Professor at Basle University.

"There he goes, the mighty, massive bird!
How languidly he lifts and dips his wing..."

These are the opening words to a poem from the unpublished posthumous works of Otto Lilienthal, the aviation pioneer.

Today the study of bird flight forms part of the training of all aviation theorists. To the aviation enthusiast, the bird signifies as much as a sacred cow to a Hindu. Yet, we venture to assert that if there had been no birds, man would have conquered the air space with greater ease.

I can foresee your protests and am willing to concede that your argument is justified—to a point: without the example of the bird constantly in mind, man would have never learned to fly. Granted, man is an egocentric. When he refers to the conquest of the air space, he thinks of people such as Clément Ader, Henri Farman, Orville and Wilbur Wright, the Montgolfier brothers, and possibly the mystery-enshrouded Chinese aeronauts who, according to the chroniclers, were the first to take to the air as long ago as 1360 A. D. And man completely overlooks that the first timid attempts at flight were made on our globe quite some time before, namely, approximately three hundred million years ago, some time during the carboniferous period. It was about that time that a kind of primitive insect, in some ways reminiscent of a dragonfly, suddenly acquired a pair of wings. The flying Saurians of the later Jurassic period emulated them about one hundred million years later, and after an interval of another fifty million years the first primitive bird—the Archaeopteryx—made its appearance. The above "dates" naturally must be assessed with caution. No records were ever "homologated" at the time. One thing seems certain, however: those early beasts (or birds?) did not take to flying with any more ease than we. The skeleton of a flying Saurian definitely indicates considerable difficulties during take-off and landing. The primitive bird which was found in the slate quarries of Solenhofen, Southern Bavaria, in 1861, is universally believed to have had a very limited radius of action. Just like those of a fledgeling, its motions are reported to have resembled a kind of frantic fluttering rather than actual flight. An outstanding expert on this Archaeopteryx, Professor M. Reichel testifies: "Its flight seems to have followed a wavy line and must have been interrupted by prolonged glides. But in no case could the Archaeopteryx have been called a high-performance soarer—for that purpose he would have had to be of entirely different design."

Be that as it may, both Bible and natural history agree that when man put in his appearance on the earth, he found it peopled by creatures that flew. According to Erhard at the "IX^{e} Congrès International de Zoologie" of Rennes, in 1914, seventy-five per cent. of all terrestial animals and sixty-two per cent. of all beasts are capable of flight. Early man found he could make use of these flying creatures in a variety of ways—he could kill them, eat them, or tame them—and he also got the weirdest ideas about flying from them. History of aviation shows that he indulged in the last-named activity on a particularly large scale.

* * *

You can count the great pioneers of aeronautics who actually evolved reasonable theories about bird flight, on the fingers of your hands: Leonardo da Vinci, Marey, Langley, Mouillard and his disciples, the Swiss Huber, Sir George Cayley, Ader, the Wright brothers, Lilienthal... That is about the lot. This group of men was faced with a whole army of people whose views were based partly on complete ignorance of natural phenomena and partly on a naive and haphazard interpretation of what was going on around them.

The danger of reaching fallacious conclusions was obviously very great. It was possible to form erroneous ideas about the medium in which birds move, namely, the air. It was easy, furthermore, to make the biggest mistakes concerning the flying technique employed by birds. But even those whose views on the properties of the air and the laws of bird flight were approximately correct, were liable to draw erroneous conclusions regarding the possibilities of human flight. Of interest are not only the usual initial errors of observation or deduction. Infinitely more astonishing are the perpetual relapses into errors that had been pointed out long ago. One might claim that in no other field of human endeavour have there been such marked periods of regression than in the interpretation of bird flight.

The Ancient Greeks, who lived along the path of the huge flocks of cranes migrating towards Asia Minor, had formed quite substantial notions about the technique of bird flight. Pliny recognised the functions of the bird's tail as an elevator. Herodotus knew that a bird must take off into the wind. Archytas of Tarentum (440-360 B. C.), a disciple of Pythagoras and a friend of Plato, constructed a small glider which, driven by compressed air, is reported to have actually flown (the world's first jet-propelled aircraft?).

Unfortunately, this vast store of knowledge was completely lost in the Middle Ages. At the time of Leonardo da Vinci the "Theory of Bird Flight" looked roughly as follows:

The primitive bird known as the Archaeopteryx was discovered at Solenhofen, Bavaria, in 1861. The piece of slate depicted is now in the possession of the British Museum.

To fly is to swim. The wings function like fins, the bird's tail, assisted by the feet, determines the direction of flight in the horizontal plane. Soaring birds maintain themselves in flight by "muscular and psychic effort." The Bird of Paradise, or *paradisea apoda,* is powered in flight by the fiery liquid it carries in its body. Where does he obtain this "fuel" ? Explorers of the Middle Ages succeeded in discovering the secret somewhere in the Orient "beyond any vestige of doubt."

"The Bird of Paradise feeds on the rays of the sun and quenches his thirst with dew. He lives in the highest strata of the atmosphere. The female hatches her eggs on the downy back of her mate. These birds only come down to earth after their death."

An all-time record was shared by the sparrow-hawk, however, since it was able to fly vertically up and down, and by a small bird called "starlet," or "*Stellino,*" which was a lover of the planet Mercury and regularly flew to the Empyrean, the highest sphere of heaven and the abode of the gods.

When you read these "theories" of bird flight you really begin to appreciate the importance of the work carried out by Leonardo da Vinci.

* * *

In all works of aviation history a place of honour is accorded to Leonardo, but the first really comprehensive and critical studies of his aeronautical manuscripts were made quite recently. They are contained in a two-volume work entitled "Histoire des Idées Aéronautiques avant Montgolfier," written by Jules Duhem, a French scientist, for the Centre National de la Recherche Scientifique (Paris, 1943-44).

Through observation, experimentation and calculation, Leonardo da Vinci gradually progressed to the point of realising the properties of the air. He learned that it was a medium which can be weighed, which furnishes resistance, is resilient and compressible ; a medium which retains heat, rises and flows in a extremely complex pattern. Unknown to him remained the fact that atmospheric pressure drops with increasing height, as a result of which he was unable to obtain an accurate notion of the nocturnal long-distance flights of migrant birds. On the other hand, he was quite familiar with the anatomical configuration of birds. He knew everything about the resemblance between bird and human skeletons—which allegedly was discovered by Pierre Belon in 1555—for he continously refers to the shoulder, upper arm, forearm, elbow and hands of a bird.

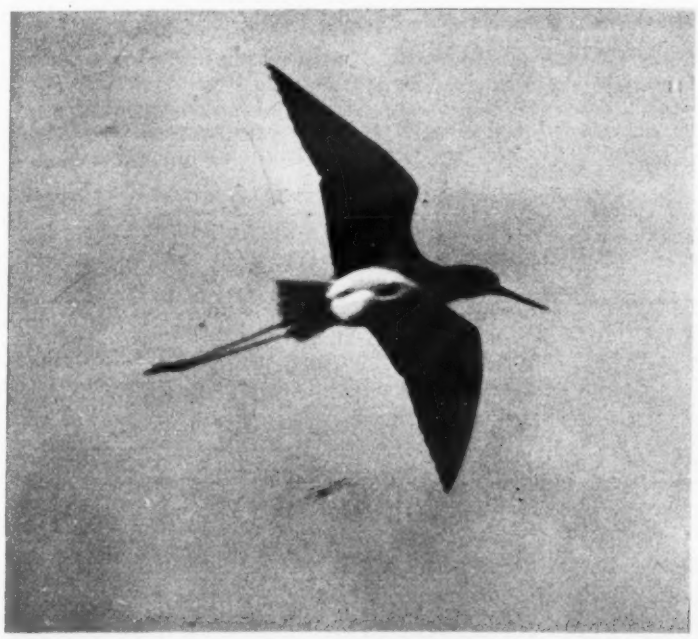
The conception of his principal work on bird flight, "Codice sul Volo degli Uccelli," took place in a positively dramatic fashion. On March 14th, 1506, he was strolling from Florence to Fiesole at the foot of the Appennines. Near Barbiga he spotted a bird of prey and immediately focussed his attention upon it. It was a milvus, or kite, which he had always considered to be a good omen, his private mascot. Suddenly he discovered that the bird glided and even soared by setting its wings at an angle into the wind. And like a flash he decided upon the plan for a book which was to clarify the problems of natural and mechanical flight. The second chapter was to have been entitled "Del Volo senza Batter Ali per Favor del Vento"—"On flight without wing-beat, with the aid of the wind."

A page from Leonardo da Vinci's "Codice sul Volo degli Uccelli," the Italian master's manuscript on bird flight. Leonardo used mirror writing, presumably in order to conceal his work from the clergy. The first transcription and translation of the "Codice" was published in Paris by Th. Sabachnikoff in 1893.

This phrase in reality embraces the knowledge which humanity had to reconquer in a 400-year struggle after Leonardo's death.

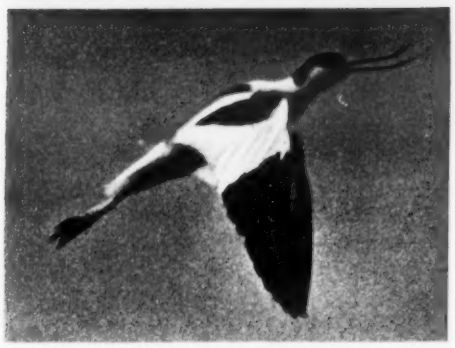
It is regrettable that Leonardo da Vinci never got down to carrying out his plan. He merely completed a draft for his book, concluding his task on April 15th, 1506, after four weeks of intensive work. Together with other products of Leonardo da Vinci's labours, this manuscript was sent to Paris by Napoleon and was later stolen. In practice, the

Want to soar ? This stilt plover shows you how.



Want to start from the slippery stones on the lakeside ?

"QFO"



Flapping flight. The bird beats its wings forwards and downwards.

pioneers of powered flight were deprived of its wisdom until 1893. The modern glider pilot would read with admiration how Leonardo calculated the stabilising and control movements of a soaring bird. However, so far as muscular flight by man is concerned, even his genius went off the track. He argued along the following lines : A bat has a wing span of just over one foot. In proportion to its size, an eagle would therefore have to have a span of about one hundred and thirty feet. In reality, its wing spread is only seven feet. From this fact Leonardo deduced that the power of the beating wing increased as the cube of its area. He went on to quote an erroneous example by comparing the strength of a single reed with the combined strength of a bundle of nine reeds. Whilst he was not unaware of the tremendous muscular power of a bird's thorax, he explained that this strength is required for fleeing and the carriage of heavy prey. On these mistaken findings he based the conclusion that the muscular strength of man should be sufficient for flight. As a cross-check he suggested the following experiment : A man should stand on soft ground and measure the depth of his footprints. He should then carry another man pick-a-back fashion and again measure his footprints. Finally, he should jump into the air as high as he can—of course without the other man on his back. On measuring for the third time he would find that, after the high jump, his footprints would be deeper even than those he made while carrying a heavy load. This was proof of the fact that man possessed more than twice the strength necessary to lift his own weight.

Fallacies—certainly. But they weigh nothing in comparison with the mountains of inadequacy and foolishness which succeeding generations piled up in the course of four centuries. A hundred years later the knowledge tediously acquired by Leonardo was lost. In 1599 an ornithologist named Aldrovandi again explained the phenomenon of gliding flight with "internal tension" and an "oscillation of the feathers which overcomes the force of gravity." In 1658 Gassendi asserted that hovering flight never existed and claimed that birds always beat their wings, even though these beats were sometimes so small as to be invisible. This error was reiterated as late as 1906 by another ornithologist, Exner. The latter would have found it easy to consult the "Codice sul Volo," since the French translation of it had been published in 1893. However, instead of troubling to wade through this work, Mr. Exner chose a simpler and, what he thought, surer way. He relied on his excellent sense of hearing and glibly wrote that birds beat their wings incessantly. He had personally heard the "whirring" of a bird of prey "hovering motionlessly" above his head (Archiv für die gesamte Physiologie, Vol. 114).

And in case you should imagine that "internal tensions" are a thing of the past, think again. In spite of Ader, Farman, Wright and the Douglas DC-3, in spite of Kronfeld and other great soaring pilots, the theory of "mystic" flight is still alive and kicking. The American ornithologist Aymar reports that as late as 1935 a well-known writer had expressed his conviction that bird flight was based on "levitation," the miracle which is claimed to have enabled the Saints to float in the air without visible means of support. According to the "expert" in question, a bird "varies the magnetic polarity of its body in such a way as to ensure that it is no longer attracted but repelled by the earth." The bird owes this ability to the fact that it "leads a pure life and devotes itself to intensive, ascetic concentration." Aymar dryly observes that it must have caused a headache to find a place for the vulture in this scheme of things.

* * *

The fallacy that man was capable of flying like a bird can also be reversed : since man cannot fly like a bird, he is incapable of rising into the air at all.

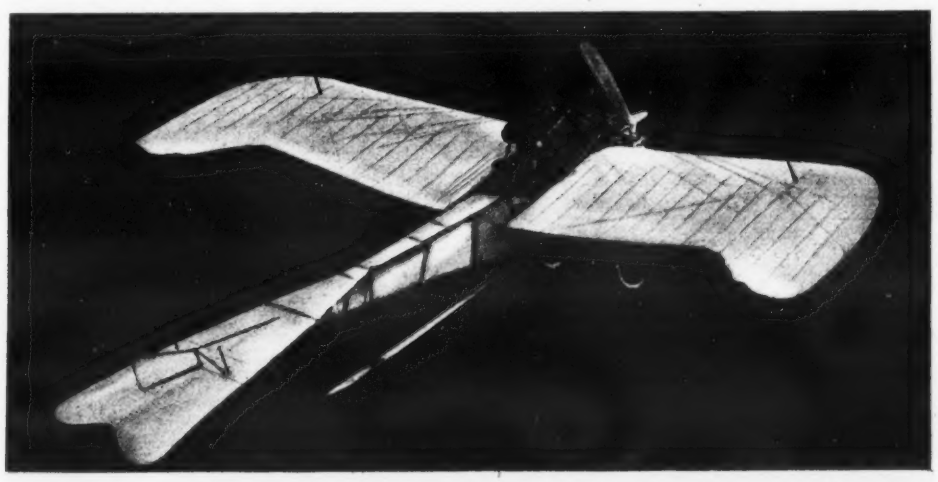
Descartes wrote in 1640 :

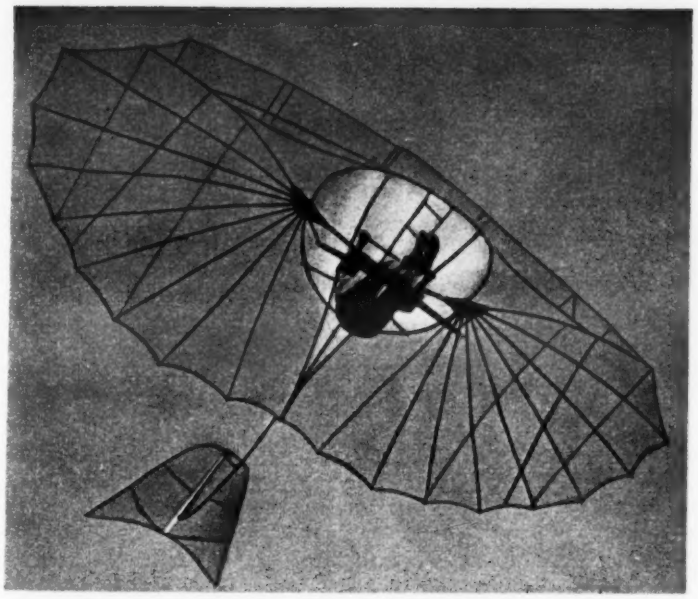
> "Metaphysically speaking, it is obviously possible to construct a machine capable of maintaining itself in the air like a bird, for birds themselves are such machines. But physically speaking, this is not possible, since the devices required would have to be so delicate, yet so strong as to make their construction by Man impossible."

Descartes and many of his contemporaries who voiced similar views deserve to be excused. They lived before the machine age. But that the great physicist Helmholtz rudely attacked that pioneer of aeronautics, Otto Lilienthal, with exactly the same arguments seems a little less pardonable. For it was Lilienthal who in his epoch-making book, "The Bird as the Fundament of the Art of Flying," took extraordinary care not to use popular fallacies or potential sources of error. Critical observation of nature, together with a talent for mathematical theory and practical technical application, enabled this precursor of aeronautics to exercise that rigid mental self-discipline which characterised him until the end of his days.

The old Vikings shaped their ships like birds. The Viking ship shown here is in the Museum Oseberg, Oslo.

The earliest aircraft designs revealed the forms of gulls, pigeons, falcons and bats. The "Rumpler Taube" (dove) dates back to 1911.





Otto Lilienthal flying his biplane glider.

Gustav Lilienthal's workshop and his grandchildren.

Here is an example of the way Lilienthal observed natural phenomena. In their youth Otto and Gustav Lilienthal read a book for boys written by the Italian balloon pilot, Count Zambeccari. Zambeccari related the old fable of the soaring stork inviting the tired wren to settle on his back and travel with him. (In fact, the stork did three things : He took the wren for a ride ; he invented the first pick-a-back combination ; and inaugurated the aerial hitch-hiking system.)

From that moment on the two brothers indefatigably watched the storks in the marshes outside their home town. Gustav Lilienthal described one of their expeditions in a preface to Otto's book :

> "Quite often we crept very close to the storks, and we did this with the wind, for the bird's olfactory sense is negligible. When the stork suddenly perceived us, he always took to the air by hopping towards us until he was able to lift himself by the force of his wing beats. This demonstrated to us that it must be easier to arise into the wind, for the timid bird would never have moved towards the source of danger without a very good reason."

The stork rendered considerable service to the Lilienthal brothers. Doubtlessly, it also led them along false tracks. Its not very good example misled them into choosing the centre of gravity of their aircraft, the "Flügel," too low, and many other deficiencies of their devices may be blamed on Mother Stork.

The most seductive temptation offered by their feathered friend consisted, however, of the constant illusion that the strength of the human musculature was sufficient to permit ornithopter flight.

* * *

On the basis of his knowledge of bird anatomy, modern man should be aware of the fact that he cannot compete with the muscular system of birds. According to Sir J. Arthur Thomson, the chest muscles of several pigeons account for about half the weight of the bird's entire body. Dr. William Beebe discovered that the pectoral muscle of a pigeon weighs one-fifth of the bird's all-up or gross weight, complete with skeleton and intestines.

The news of these discoveries seems to have fallen on deaf ears. Modern man still dreams the old dream of human flight by muscular effort. Winged bicycles have jumped and still jump over eight-inch obstacles. Cranks have been cranked, treadmills trodden, and stretchable chords stretched.

We shall beware of annoying muscular flight enthusiasts and merely invite the reader to carry out an experiment at home, so to speak :

> If a man weighing 165 lbs. runs up the stairs to the third floor of his house (33 ft.) and succeeds in doing so in ten seconds, he will have used one horsepower. We would then recommend him to climb to the thirtieth floor (330 ft.) of the Empire State Building of New York in one hundred seconds, in order to convert his momentary success into a continuous performance.
>
> Should he also pass this test, he would still lag considerably behind the average performance of a sparrow, but would nevertheless qualify for permission to join the discussion on muscular flight.

* * *

It would be an idle undertaking to try to equal the physical endurance of birds, since aviation has long ago outpaced the bird and has surpassed its performance many hundred times over.

There is no doubt that birds fly fast. Most of us do not even imagine that certain birds fly at speeds of up to 200 m.p.h. Colonel Meinertzhagen, a Britisher, computed with anti-aircraft measuring instruments that the martlet, one of the fastest birds, often attains more than one hundred miles per hour. Mr. E. C. Stuart-Baker records that in India he checked the flight of two species of martlet by stop watch over a two-mile distance and recorded speeds between 170 m.p.h. and 200 m.p.h. Nor does the service ceiling of these feathered flyers leave anything to be desired. A Royal Air Force squadron observed peewits at over 7,000 feet, ducks at 7,500 feet and rooks at 11,000 feet. The longest flight recorded with a ringed bird is the one made by a common tern which was marked as a fledgling on July 23rd, 1928, in its nest on Turnevick Bay, Labrador. It was found again on November 14th, 1928, on a beach at Margate, fifteen miles southwest of Port Shepstone, Natal, on the East Coast of South Africa. The shortest distance between the two points measures about 8,000 miles and the actual route covered by the bird was probably nearer 9,000 miles.

However, modern aeronautical science has not much more to learn from birds. As "guinea pigs" they have long been superseded by the wind-tunnel model.

Nevertheless, we have no reason to be presumptious. Today, on the eve of rocket space flight, we once again find ourselves faced with a tedious job of observation. We shall always be Nature's apprentices. The scientific research methods of modern astrophysics have given us astonishingly accurate information on the composition, weight, and physical properties of the celestial bodies. But nobody knows what things really look like up there in space. Nobody can tell what shape a vehicle must have in order to move successfully through the endless space of the planetary system. A well-known astronomer, asked to give his views on the efficiency of the design of modern rockets, declared : "For the time being, the celestial bodies do quite well in moving through the universe. That is probably so because nobody interferes with them. Nobody expects them to do anything but rotate about their own axis and revolve about the major celestial bodies. Now, if they were suddenly required to move from a determined point of the universe to another determined point, according to a determined schedule... who knows what forms they would then have to assume ?"

You see—once again we have come to a point of utter ignorance. We shall have ample opportunity of making errors of observation as spectacular as those of our predecessors in their interpretation of the whys and wherefores of bird flight. It is the fate of Man ever to remain a pioneer. The great Newton himself said :

> "I do not know what I may appear to the world, but to myself I seem to have been only a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

Dr. H.

Breda Zappata BZ. 308

Europe's Newest Big Airliner

Breda engineers and workers had waited three years for this moment : the BZ. 308 taxiing under its own power to the runway.

In Western Europe "home-built" big airliners are still very few. The airlines' long-range equipment mainly consists of American airliners, such as the "Constellation," DC-6 and DC-4, which, developed by strongly-financed firms, were put into high-scale serial production and were ready for operation very soon after the war, and on sale at advantageous prices.

All the more appreciation, therefore, is due to the efforts of the British, French and Italian industries to catch up on the indisputable technical and economic advance of the U.S.A. in this respect. The type giving rise to the greatest hopes — primarily because of its later equipment with propeller-turbines — the 285,000-lb. Bristol "Brabazon I," will not fly for another few months, and even then will only be fitted with reciprocating engines. Also the French SE 2010, a 160,000-lb. airliner developed by SNCA du Sud-Est, is only in the taxi-trial stage. However, there is a new European airliner which recently effected a successful first flight : the Breda-Zappata BZ. 308.

Designed by *Mr. Filippo Zappata* and developed during the past three years by the Aviation Division of the *Società Italiana Ernesto Breda,* of Milan, it is a four-engined commercial transport of 105,800 lbs. gross weight, with a projected seating accommodation for 55 to 80 passengers. Mr. Zappata has designed several military landplanes, but his name is best known in connection with a series (Cant. Z.) of successful seaplanes, which were manufactured by Cantieri Riuniti dell'Adriatico, a firm whose Monfalcone headquarters are today situated in the Free State of Trieste. One of his last designs, the four-engined Cant. Z. 511 seaplane for mail and passenger transportation on overseas routes, grossed 79,000 lbs. and was similar in many respects to the present-day BZ.308.

The fact that the prototype could be completed in the remarkably short time of three years, notwithstanding the manifold obstacles provided by the aftermath of war — bomb damage, disrupted economic and social con-

After several taxi trials over the rather rough grass surface of the factory airfield at Sesto San Giovanni, Milan...

ditions, inflation and shortage of capital — is good proof of the unbroken will and determination of the north-Italian industry. With the same energy with which the Milanese began to rebuild their shattered city, work was begun on the realisation of the new big airliner in the Sesto San Giovanni suburb.

The BZ. 308 is destined primarily for trans-Atlantic services between Italy and the Latin American countries, and for operation by both Italian and South American airline companies. Four units have already been ordered by the Argentine Government. The manufacturers, however, also intend to provide versions for continental services within Europe.

An all-metal low-wing monoplane with tricycle undercarriage, it is mainly characterised by its noticeably large wing, spanning 138 feet, resulting in relatively low wing loading and wing power. This of course renders the flying speed — 267 m.p.h. on 5,000 H.P. cruising power — somewhat lower than it would be with higher wing power; on the other hand, however, in view of its moderate landing and take-off speed, the aircraft can also operate from rather primitive airfields (as the photos show), and attains a good service ceiling.

The manufacturers require an engine take-off power of 10,000 H.P. or more. The prototype is equipped with Bristol "Centaurus 568" air-cooled 18-cylinder twin-row radials, each furnishing about 2,500 H.P. for take-off and 1,650 H.P. at continuous r.p.m., driving five-blade Rotol controllable-pitch propellers. Alternatively, U.S. engines of the same power class, *e.g.* Wright R-3350 "Cyclone 18" or Pratt & Whitney R-2800 "Double Wasp" radials, can be installed.

Dimensions:

Span	138 ft. 1 in.
Length	110 ft.
Height	23 ft. 6 in.
Wing area	2,224 sq. ft.

Weights:

Max. take-off weight:	
overseas operation	105,800 lbs.
continental operation	92,600 lbs.
Max. landing weight	88,200 lbs.
Tare weight	59,500 lbs.
Disposable load (overseas operation)	46,300 lbs.
Max. fuel load (4,110 Imp. Galls.)	29,700 lbs.
Oil	2,200 lbs.
Crew (six members)	1,100 lbs.
Payload	13,300-17,700 lbs.

Comparative Values:

Wing loading at take-off:	
overseas operation	47.5 lb./sq. ft.
continental operation	41.5 lb./sq. ft.
Power loading at take-off:	
overseas operation	10.6 lb./H.P.
continental operation	9.3 lb./H.P.
Wing loading:	
at take-off	4.5 H.P./sq. ft.
at max. continuous output	2.9 H.P./sq. ft.

Design performance data:

Max. speed at 11,500 ft.	317 m.p.h.
Max. cruising speed at 11,500 ft. (on 6,500 H.P.)	289 m.p.h.
Normal cruising speed at 11,500 ft. (on 5,000 H.P.)	267 m.p.h.
Max. range at 267 m.p.h. and 11,500 ft.	3,300 miles
Max speed at 19,700 ft.	348 m.p.h.
Service ceiling	26,200 ft.
CAA take-off runway (on three engines)	4,600 ft.
CAA landing runway	3,950 ft.

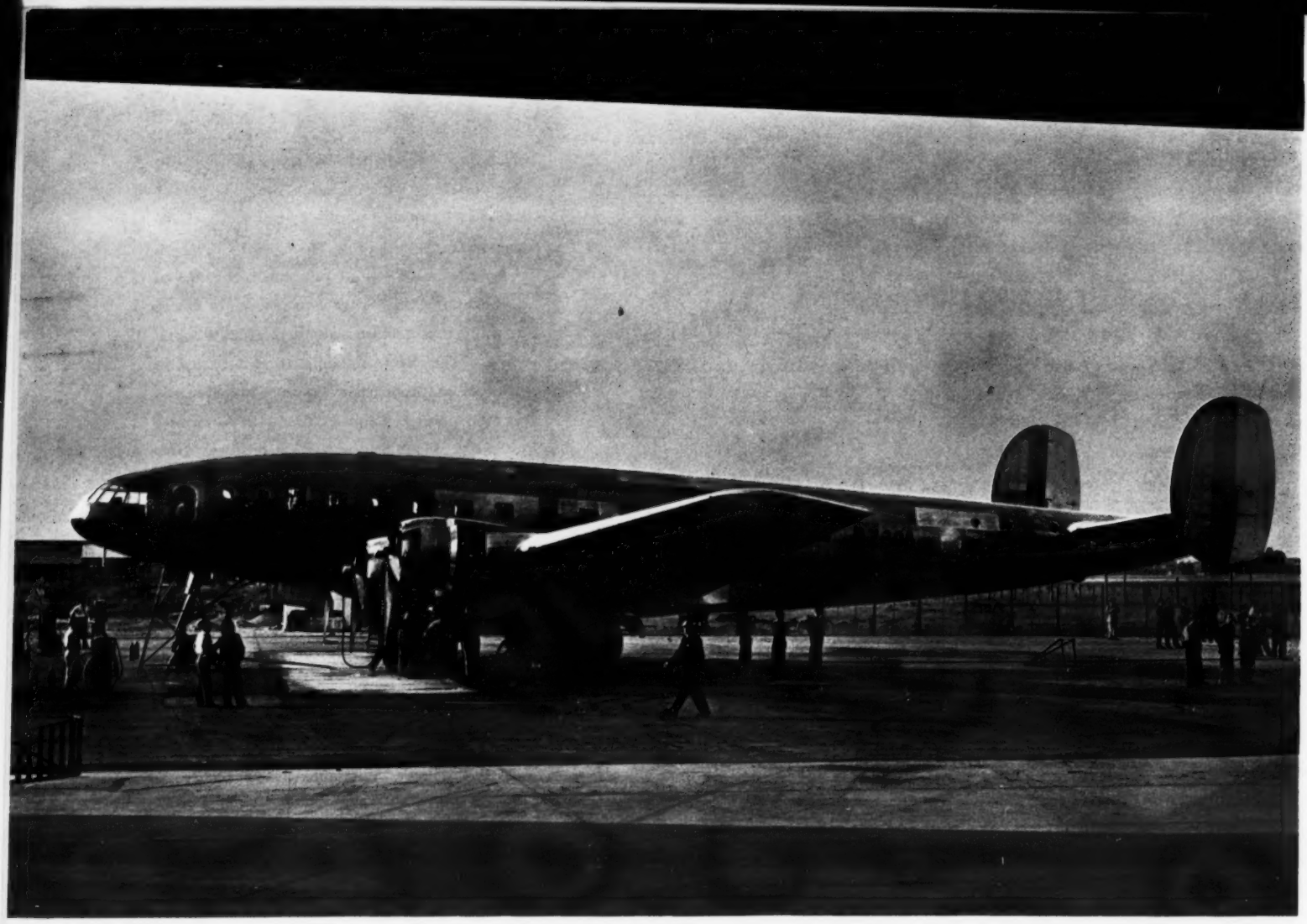
Construction:

The wing is built up of an approximately rectangular centre section of about 60 feet width, carrying the four engine nacelles, and two trapezoidal outer wings tapering at a rate of about 1 : 2. It has two spars and is made of high-strength aluminium alloys. The front I-spar is located at about 25 per cent. chord and the rear one at about 75 per cent. Between them are located about fourteen fuel tanks of 4,110 Imp. Galls. total capacity, eight being in the centre section and three in each outer wing. The four oil tanks are positioned in front of the main spar. Numerous ribs, and formers located between them, have enabled an exceptionally strong torsion-resistant structure to be produced, of which the elastic axis moreover, largely coincides with the centre of pressure line. The considerable thickness of the wing centre section has allowed for the installation of a catwalk to the engines and fuel tanks in the wing leading edge, which is accessible from the fuselage in flight and can be reached through hatches near to each engine nacelle when the aircraft is on the ground. Flaps are located between the very large ailerons.

The fuselage, of monocoque construction, features two decks, one being for passengers and the other, traversed by the wing centre-section spars, for cargo.

The front tip of the lower deck is given over to containing the retracted nose-wheel; then comes the forward cargo hold, the wing centre section, and finally the rear hold. A gangway, running the length of the floor of the aircraft and containing loading hatches, divides each cargo hold symmetrically (see photo); the holds are accessible from the upper deck during flight, and measuring 210 and 230 cu. ft. respectively, provide ample space. On continental operations, the two innermost fuel tanks, which are made superfluous in view of the shorter trip lengths, can be removed, providing two further cargo holds each of

... the big four-engined airliner took off for its first flight on August 27th, 1948, with Commandante Mario Stoppani and the designer, Mr. Filippo Zappata, at the controls



The 105,800-lb. BZ. 308 airliner has an economic cruising speed of 267 m.p.h. over a range of 3,300 miles...

... thanks to four Bristol "Centaurus" sleeve valve engines delivering together more than 10,000 H.P. take-off power and driving five-blade Rotol controllable-pitch propellers.

90 cu. ft. volume. Moreover, the space between the wing centre section spars can be used to provide 250 cu. ft. for cargo storage. In this way there is a total of 870 cu. ft. cargo volume available in the lower deck and wing.

On the upper deck is the cockpit with two pilots' seats, dual controls and the latest in instrumentation. It is followed by the stations for the navigator and the flight engineer, complete with everything in the way of control and servicing equipment, and finally the radio operator's compartment. According to customers' wishes, there can be two or more passenger cabins, accommodating 49 to 80 passengers, some eventually with sleeping berths. The differences between the various versions will be discussed later on ; it suffices to say here that the Breda firm is having even the prototype fitted out by reputed interior decorators, so as to provide the last word in comfort and luxury. The passenger cabins will be 9 ft. 6 in. wide and provide 7 ft. 6 in. headroom ; the entire useful length will amount to between 50 ft. 6 in. and 60 ft. 9 in. The passenger cabins are followed by a vestibule with access to the galley, luggage compartment, two lavatories and the "entrance hall." Passengers will enter the BZ. 308 through the fuselage underside, the "doorway" being provided by a built-in ramp stairway which can be lowered to the ground. Special doors for crew members and three emergency exits for passengers are located in the sides of the fuselage. Large cabin windows offer excellent visibility conditions, and the most modern devices will be provided for sound-proofing, ventilation and heating. However, the BZ.308 will not be pressurised, but provision is made for a BZ.308 *bis* version with pressure cabin.

Other features are the twin nose-wheel and the single-tread main landing wheels. The entire undercarriage is retracted by hydraulic means ; the retracted nose-wheel se als offthe underside of the fuselage nose, whereas the main wheels protrude a little when drawn into the inboard engine nacelles. The tail assembly is of metal, and it has not yet been decided whether the present twin-rudder arrangement will be replaced by a single large rudder.

Interior Layouts

Almost every corner of the spacious fuselage can be put to good use, so that many types of cabin layout can be devised, which, according to the wishes of the customer, can be very luxurious or very "commercial," or else provide a sober medium.

Apart from the differences between overseas and continental operations, the manufacturers have planned six types of interior layout.

1) *55-passenger normal version :* two compartments, the front one being 21 ft. 8 in. long with 24 seats, a folding table and a window being allocated to each four, and a rear compartment 28 ft. 10 in. long with 31 seats arranged in a similar manner.

2) *64-passenger version :* two compartments, the front one being a bar, 24 ft. 8 in. long and accommodating 26 passengers on four upholstered seats along the wall and eight chairs around two tables ; the rear cabin, 36 ft. 1 in. long, seats 38 passengers in the same way as in the normal version.

3) *74-passenger version :* three compartments, the first being 17 ft. 5 in. long, serving as a bar for 17 passengers seated on four couches ; the centre compartment, 21 ft. 8 in. long, featuring 30 seats in rows of three (or two) on either side of a central aisle ; and the rear compartment, also 21 ft. 8 in. long, accommodating 27 passengers in the same manner.

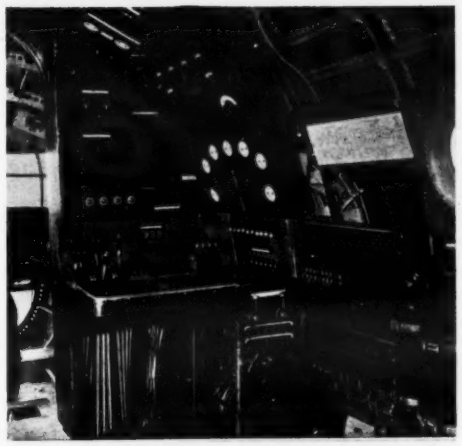
4) *80-passenger version :* three compartments, 21 ft. 11 in., 18 ft. 1 in. and 21 ft. 8 in. in length, with three (or two) rows of seats side by side, for 28, 25 and 27 passengers.

5) *49-passenger version :* three sleeping compartments in front, with twelve berths, and 37 seats in a rear cabin.

6) *Version for 31 passengers and 3 to 4 tons of low-density cargo :* two compartments, the front one for cargo, 21 ft. 8 in. or 24 ft. 9 in long, with large folding hatches, and a rear one with 31 seats arranged as in the normal version.

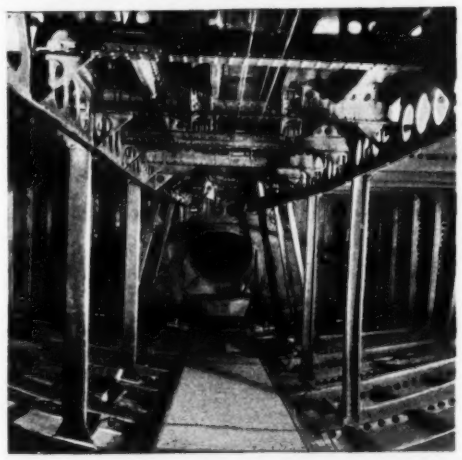
Further versions can be constructed according to customers' wishes, just as the power plant equipment can be modified. And then, of course, there is the pressure-cabin version mentioned earlier. Meanwhile, the manufacturers are also planning to place the entire aircraft on floats, in which case it would be known as the BZ.408. The experience gained with the 79,000-lb. Cant. Z. 511 will stand them in good stead in this respect. The two floats, which will certainly be rather enormous, are to provide extra cargo space and be accessible from the wing through the thick struts, in order to facilitate tow and mooring operations. The low wing loading featured by the BZ.308 will favour this project, though it is evident that cruising speed and payload will suffer noticeably.

For the time being, however, the prototype has flown, and the first big European airliner of a series of projects has received its aerial baptism.



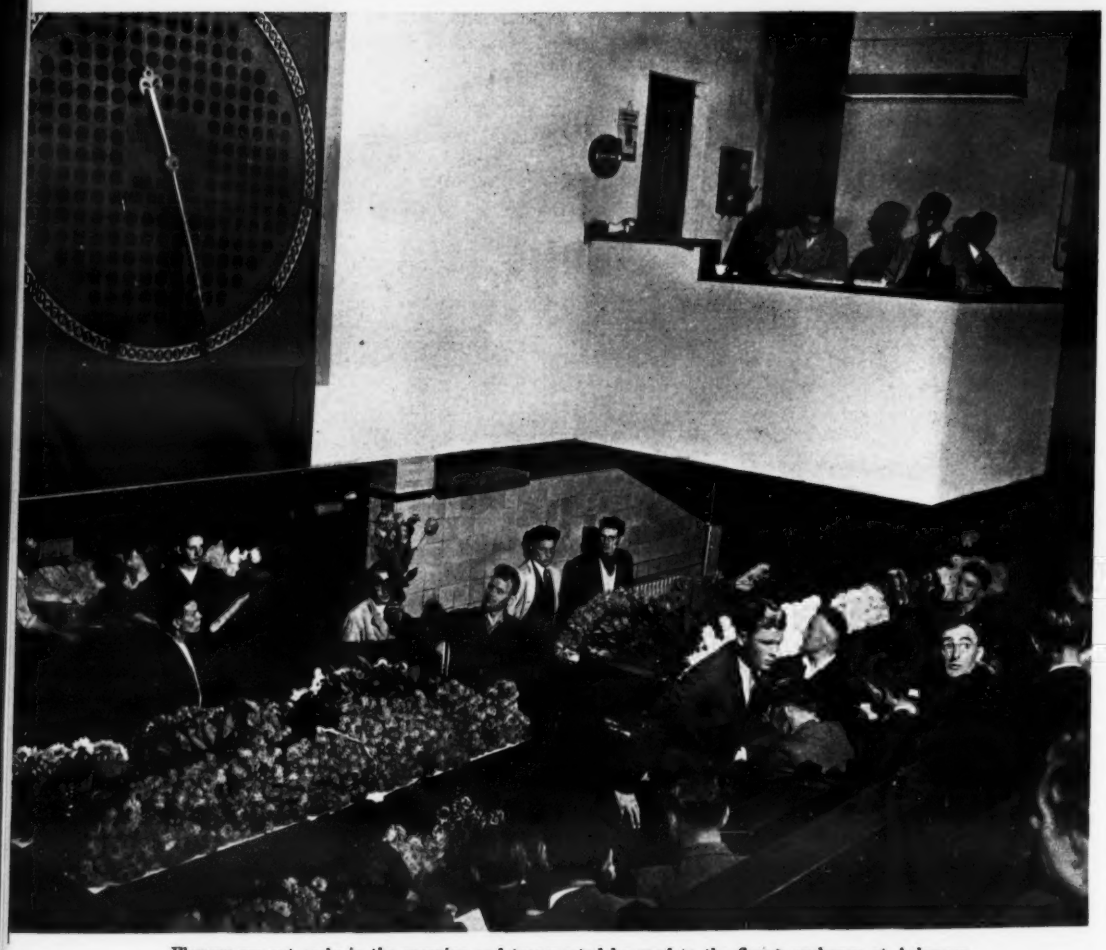
Flight engineer's station.

Rear passenger compartments under construction.



One of the cargo holds on the lower deck, showing gangway and loading hatch.

A catwalk inside the wing provides access to the engines during flight.



Flowers are cut early in the morning and transported by road to the flower-exchange at Aalsmeer.

Potted plants go by barge.

Flying Flowers

Erstwhile and Present Express Post

Letter-writers will be prosecuted.

Post office authorities all over the world are now advising us to post early for Christmas.

Three or four days before the great day, gifts of choice cigars, wines and liqueurs, turkeys and plum-puddings, chocolates and fresh flowers, are lovingly packed in attractive boxes. A few hours later, an aircraft touches down at London or Paris, Algiers, San Francisco or New York.

We have no reason to complain about too slow delivery nowadays.

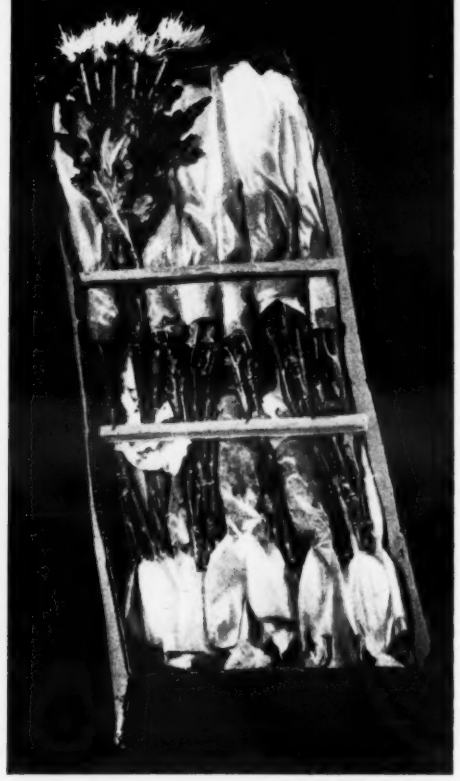
Two centuries ago, when letters were sensible and written for a purpose, people were more patient. Goethe, quite a writer, wrote a letter home every day when he was in Italy. But he was content if they could leave in bunches once a week by postchaise. And for the trip from Rome to Weimar, about 800 miles, he reckoned a full sixteen days. In fact, notes he wrote on December 14th, 1786, reveal that he only became impatient if the delivery took longer than that.

It may surprise you to learn that there was a time when it was forbidden to use the government mails for sending private letters... not to speak of chocolates and the like.

The mail service in Ancient Rome was expensive, complicated and tediously-long. The *cursus publicus,* the Roman imperial mails of the time of the Caesars, was reserved exclusively for despatches of State importance. Officials desirous of sending articles by it, or eventually travelling by it themselves, had to produce a certificate signed by the reigning Caesar—a "diploma," hence the word and concept "diplomat."

Oddly, the "no diploma—no trip" idea does

A quarter of an hour by truck from Aalsmeer to Amsterdam's Schiphol airport.



Light, long boxes are used for sending flowers by air. Buds are turned towards the outside and stems are put in splints. Tissue paper, wood shavings and dry ice protect the contents.

not sound all too ancient to modern ears. The average European, at least, will not be unduly surprised to read that the Roman writer and official, Pliny, had to excuse himself a thousandfold before his Caesar because he had taken the liberty of granting his own wife a diploma to travel to her dying father in Rome. A certain army officer, Pertinax, was still less fortunate. Wishing to join his unit as quickly as possible, he had to go on foot because his diploma was not renewed in sufficient time. However, we had better stop giving examples of how the ancients invented restrictions and bans on travelling : modern officials might start getting ideas !

A "Constellation" of KLM carries a delicate shipment.

Lucky New Yorkers can have live lobsters brought in by aircraft from Maine. Lobsters being unloaded from a C-46 at San Diego.

Who says ostriches can't fly ?

Airmails before aircraft.

Damiri, a wise man of Arabia, relates in his book on animals, of the express transportation of fresh cherries to Cairo. Caliph Aziz suddenly had an irresistible yearning for cherries. The Vizier of Baalbeck, hearing of this, sent six hundred pigeons to Cairo, each carrying a little bag of cherries attached to one leg.

The first example of air cargo !

The strangest part of this story is that it does not seem in the least impossible. Sauvaget, in his doctor dissertation (Paris, 1941) on the postal service of the Mamelukes, tells of a scheduled service by pigeons : Bhira—Aleppo — Hama — Damascus — Gaza — Cairo, with connections to Rhaba, Baalbeck, Jerusalem and Alexandria. Towards the end of the XIIIth Century, the central pigeon station in Cairo boasted 1,900 birds. As a matter of course, only extremely light-weight commodities were transported. Special dimensions were stipulated for official communications.

The first airmail letters !

*

The carriage of perishable goods, notably articles of food, did not begin until fairly recently. It is not as if the Ancient Romans were not connoisseurs. On a 2,000-year-old stone table unearthed not so long ago at Pompei, are the words : "Remember, O stranger, that Sajus, the limper, serves the finest Falernian wine and the tastiest oysters. Go, therefore, only to Sajus, whom you will find in the street which is not without reason called Street of Plenty." But transport conditions of those times did not allow for delicate food to be sent very far. The most that could be carried were spices from the East, dried fruits from Africa, and pearls which, we are told, were dropped into goblets to purify the wine.

*

Later on, even the railways turned out to be too slow for certain commodities. It is only today that, thanks to the aeroplane, New Yorkers can enjoy fresh lobsters from the State of Maine, Londoners obtain strawberries picked the same day in Italy, South Africans decorate their homes with flowers from France or Holland.

Everybody happy ?

During the Olympic Games in London, the Swedish team had a longing for Scandinavian cooking. (Try the Londoners' diet for a few weeks before screwing your nose up.) One day an urgent telegram reached Stockholm : "BLUEBERRY SOUP STOP LOTS OF IT URGENT STOP." The cargo division of Scandinavian Airlines System promptly arranged for a fifty-litre shipment the same day . . . and continued the same operation every day until the Games were over. The result was a nice collection of gold, silver and bronze medals.

On the birthday this year of the King of Denmark, which he spent in New York, his compatriots sent him smørrebrød, orchids and wild flowers by air. The royal Swedish tennis player, Mr. G., on his 90th birthday, received by air a patriotic bouquet of blue orchids and yellow roses. But the aircraft does more besides carrying tender tribute to kings and athletic heroes. During the Spring of this year, Holland exported 75 tons of strawberries by air, and at the beginning of Autumn, a DC-4 of KLM carried eight tons of grapes to England. The greater part of this year's North-African and Spanish orange harvests is going on board cargo aircraft.

The aircraft is particularly suitable for transporting cut flowers. During the first five months of 1948, KLM carried about 190,000 lbs. of cut flowers to all parts of the world. Tulips, carnations, roses, lilac, chrysanthemums and orchids are grown in Aalsmeer, the Dutch flower centre . . . Should any lady or gentleman (cross out where necessary) think of me : I love fresh tomatoes. *He.*

The Reason for Larger and Faster Airliners

Every time an airline company is in a position to replace its twin-engined DC-3s with new airliners, it chooses larger and faster types. And every time an aircraft manufacturing firm puts on the market a modern medium-range commercial transport, this has a larger seating accommodation and a higher cruising speed than the DC-3. Indeed, it would appear that within the next few years, there will be no aircraft offered for sale which cannot simply replace the DC-3 without requiring a revision of schedules, or be alternatively operated over the same routes at the same time as the DC-3.

Is this tendency towards larger and faster airliners, which influences schedules and consequently the entire character of medium-range civil air transport, merely the outcome of unfounded postwar optimism ? Or can it really be justified from a commercial standpoint ? The question cannot be answered offhand ; but we shall endeavour to clarify it by giving an example which could happen in practice, and by indicating the advantages and disadvantages of this indisputable trend in present-day civil aviation.

The problem takes on a new aspect for each route, each route network, and each airline company. If a company has to operate airliners of a definite type, it really depends on chance circumstances whether it can at all establish schedules which meet the most elementary requirements of commercial airline operations, regardless of the number of aircraft available. These requirements might be as follows :

a) For each flight at the time of departure there should be an aircraft available on the airport of departure and, if possible, a reserve aircraft should stand ready ;

b) On the average each aircraft should be operated for a time which is neither longer nor shorter than is compatible with the plan for carrying out the prescribed periodic overhauls ;

c) On every route they should be per day no more and no less passenger seats available than is required by the passenger potential.

To these come further desires : times of departure and arrival should be adjusted to suit the daily habits of passengers ; crew members should be relieved at suitable intervals and in such a manner that they can easily reach home when on furlough ; the last daily route section of each aircraft should end at an airfield providing adequate hangar and maintenance facilities.

In practice, it is only exceptionally that a schedule can simultaneously meet all these requirements. It almost invariably occurs that one or the other aircraft must do a little more or less than its normal daily work, and it nearly always happens that, even if the passenger demand is quite regular *(e.g.* 100 passengers per day), one or the other flight *(e.g.* the third flight of a 40-passenger airliner) has either to be carried out with an insufficient number of passengers on board, or else cancelled.

It would appear, from a general comparison of the commercial peculiarities of different aircraft types, that such shortcomings in the schedules can neither be taken into account nor disregarded. If an airline operator wished to take them into account, that aircraft for which the schedule turns out unfavourably because of speed, trip length, ratio of passenger accommodation to passenger demand, etc., would invariably appear in an unfavourable light ; and if he decided simply to overlook any shortcomings in the schedules, then the comparison would be purely theoretical. In view of this dilemma, we are forced to base our investigations on precisely one of those exceptional cases where more or less ideal schedules can be established with each one of the aircraft types under consideration.

Operations with Douglas DC-3s

We shall begin with the following assumption : an airline company, which we shall call " Abecedair, " operates scheduled services between the important cities of Alpha and Beta, which lie 420 miles apart from each other—thus a typical medium-range or continental operator. Up to 160 persons travel by air from Alpha to Beta every day, and the same number in the reverse direction. (For the sake of comparison: an average of 90 passengers now fly daily on the 42 per cent. longer route from Chicago to Washington.) Like many other companies, Abecedair utilises Douglas DC-3s for this purpose, carrying, in view of the trip length, twenty passengers on each flight. Eight flights daily in each direction are therefore necessary, which, for the sake of simplicity, we shall assume to be evenly distributed throughout the day, between 8 a.m. and 10 p.m.

On usual engine cruise power, each flight requires 2 hours 30 minutes from stop to stop. In the case of operating-cost computations of this nature, the usual practice is to calculate the daily flight duration at ten hours, thus the annual duration at 3,650 hours. In the present case, therefore, four flights could be carried out daily with each aircraft, so that four aircraft would be sufficient to operate the entire schedule. In reality, however, the mean daily and annual duration of utilisation of flying equipment in present-day civil aviation is still much at variance with this ideal value. Abecedair will therefore be wise enough to calculate that each aircraft can only be utilised on the average for three flights, thus for seven and a half flight-hours daily, but will also make provisions for using it for four flights on certain days, *i.e.* for ten flight-hours.

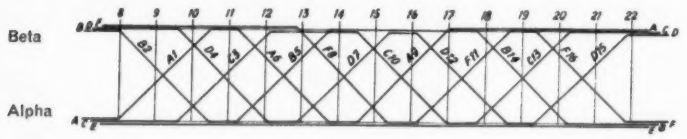
In the present case, on the basis of the average requirements of three flights per day and aircraft, $16 : 3 = 5\ 1/3$ aircraft are necessary for the eight scheduled round trips. Abecedair must therefore possess six aircraft, of which one can eventually be overhauled or held in reserve if, on this day, one of the other five is utilised 1/3 more than the average, thus for four one-way flights. The annual utilisation of each of the six aircraft then amounts to 2,433 flight-hours. Furthermore, the company employs three crews for each aircraft, each one of which flies 811 hours annually (instead of the usual 850 hours for the pilot and the co-pilot, 950 hours for the air hostess).

Under these conditions the foregoing schedule can be drawn up for operating the route under consideration. Each flight is characterised by a letter and a number, the letter indicating the aircraft used, and the number refering to the flight, whereby uneven numbers refer to outbound flights (Alpha-Beta) and even numbers to return flights (Beta-Alpha).

ABECEDAIR — DOUGLAS DC-3

Outbound flight	A1	C3	B5	D7	A9	F11	C13	D15 §
Alpha dep.	08 00	09 38	11 15	12 52	14 30	16 08	17 45	19 22
Beta arr.	10 30	12 08°	13 45*	15 22	17 00°	18 38	20 15	21 52
Return flight	**B2**	**D4**	**A6**	**F8**	**C10**	**D12**	**B14**	**F16**
Beta dep.	08 00	09 38	11 15	12 52	14 30	16 08	17 45	19 22
Alpha arr.	10 30	12 08	13 45	15 22	17 00	18 38	20 15*	21 52*

° Aircraft misses one departure and stays in reserve at Beta.
* Aircraft stays overnight.
§ Fourth flight of aircraft D.



Graphic presentation of the above schedule. The hours of the day are plotted from left to right ; the thick lines show the positions of aircraft A, B, C, D, E (reserve) and F as they travel between Alpha and Beta,

On the following day aircraft D takes over the schedule of aircraft A, F that of C (both at Alpha) ; furthermore at Beta, A takes over that of B, C that of D, and the latter that of F (whereby D returns in the evening to Alpha where overhaul facilities are available). Aircraft E, being overhauled at Alpha, can at any time take over the schedule of an aircraft which may require overhauling, providing the latter comes to Alpha for a short off-service period or for the night ; this applies to each aircraft twice daily. According to the schedule, there is also a replacement aircraft available at Beta at every time of departure, should the regular aircraft be temporarily hindered from taking off. This well-developed scheme for interchanging the numerous aircraft operating over the route enables unforeseen incidents to be met with complete confidence.

Operations with Larger and Faster Aircraft

In what way must Abecedair organise its operations over this route if it is to keep up with the times and replace its Douglas DC-3s with larger and faster twin-engined airliners ? A glance through a catalogue of modern types, already available or in development, presents roughly the following selection :

	Douglas DC-3	SAAB Scandia	Douglas DC-9[1]	Martin 2-0-2	Convair -Liner	Air-speed Ambas-sador
Seat accommodation	20–21	24–32	28	36–40	40	40–44
Engine take-off power (H.P.)	1,200	1,800	1,475	2,400	2,400	2,700
Cruising altitude (ft.)	10,000	10,000	10,000	12,000	16,000	16,000
Engine cruise power at this altitude (60% METO) [2]	630	840	765	1,080	1,080	1,388
Cruising speed (60 % METO) [2]	194	238	242	256	277	271
Flight duration from stop to stop (420-mile trip)	2.49	2.02	2.00	1.91	1.81	1.85

[1] Project not carried out.

[2] We seize this occasion to clarify a point in our review of " Twin-Engined Commercial Transports " (Interavia, Review of World Aviation, Vol. III, No. 10, pp. 569-574). The cruising speeds of the individual types, indicated in the table, apply for the cruising altitude and cruising power given in each specific case. If the indicated cruising power is lower in proportion to the take-off or METO (Maximum Except Take-Off) power (*e.g.* in the case of the Airspeed " Ambassador, " where it is 36 per cent. of the take-off power and 42 per cent. of METO power), then the indicated cruising speed may not be compared directly with that of another type, which is attained at the penalty of higher engine loading (*e.g.* the Martin 2-0-2 : 60 per cent. of the " dry " take-off power or 70 per cent. METO). In the present table, all data refer to 60 per cent. METO and the cruising altitude indicated here.

It is not for us to make a precise comparison of all these aircraft types, but to state the reason for which larger and faster airliners should be utilised. The more exact investigations should be carried out by Abecedair themselves.

For the purpose of comparison with the DC-3, let us replace the five new aircraft types mentioned above by two airliners having imaginary names, the one embodying the main characteristics and performance of the " Scandia " and the Douglas DC-9, the other being somewhere between the three larger types :

a) The " Scalas " for 32 passengers ; two fourteen-cylinder engines each furnishing 850 H.P. cruise power at 10,000 ft. ; requires exactly two hours to fly the route under consideration.

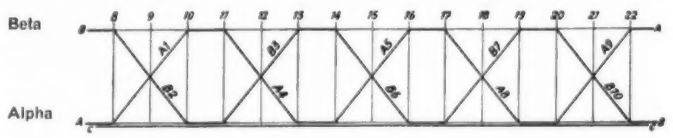
b) The " Continador " for forty passengers ; two eighteen-cylinder engines each furnishing 1,200 H.P. at 1,600 ft. ; pressure cabin ; requires 1.875 hours = 1 hr. 52½ mins. for the route in question.

Five round trips daily are necessary in order to carry the anticipated 160 passengers in each direction with the " Scalas, " which accommodates a maximum of 32 passengers. Based on a utilisation of seven and a half hours per day, each aircraft can average 3.75 flights of two hours daily, so that 10 : 3.75 = 2 2/3 aircraft are necessary for operating the line. If the company has three aircraft available for this route, it can keep one in reserve, but must then employ the other two for one third over the daily average, thus for ten hours or five flights. The annual number of flight hours again amounts to 2,433 and the schedule takes the following form :

ABECEDAIR — " Scalas "

Outbound flight	A1	B3	A5	B7	A9
Alpha dep.	08 00	11 00	14 00	17 00	20 00
Beta arr.	10 00	13 00	16 00	19 00	22 00*
Return flight	**B2**	**A4**	**B6**	**A8**	**B10**
Beta dep.	08 00	11 00	14 00	17 00	20 00
Alpha arr.	10 00	13 00	16 00	19 00	22 00*

* Aircraft stays overnight

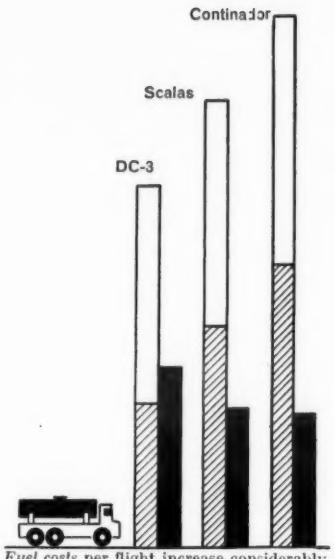


Graphic presentation of the above schedule with two " Scalas " airliners (A and B) in service and a third " Scalas " (C) in reserve.

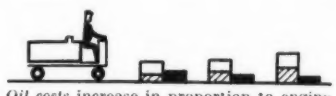
On the following day aircraft A and B change places. A chance to be replaced by the reserve aircraft C is offered to the aircraft staying overnight at Alpha and twice during the day to each of the aircraft in operation. Otherwise, however, it is no longer possible to interchange the aircraft ; there is never a second aircraft available at all at Beta. Operations are therefore considerably less flexible, and technical disturbances must inevitably set the schedule back somewhat. In spite of the fact that the number of hours flown annually remains the same, the two aircraft operated each day are subjected to a far greater strain, namely always ten hours a day. On the other hand, it should be a little easier to catch up on delays during the day, or to arrange the times of departure in such a manner that they suit the travelling public, since the shortened flight duration is coupled with somewhat longer stops at airports.

An explanation is indicated at this point. For present-day aircraft of the " Scalas " class, it is a fact that 32 is the largest number of passengers which can be accommodated. On the average, however, there are usually 28 passengers. In view of this reduced passenger load, meanwhile, the six flights necessary for transporting 160 persons daily in each direction require, at the same speed, theoretically 3 1/3 instead of 2 2/3 aircraft—in practice, therefore, four instead of three aircraft. The average number of hours flown annually with each of these four aircraft will consequently amount to only 2,190 instead of 2,433, which would be contrary to the conditions of our commercial comparison. However, a solution of this sort would make it easier to keep a reserve of aircraft on one side, reduce the daily strain on the aircraft in service, and would, from the purely operational standpoint, offer considerable advantages.

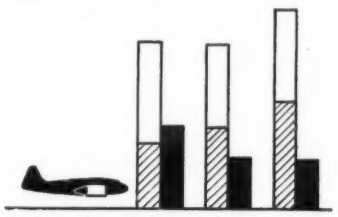
Conditions take on an entirely contrary aspect if the DC-3s are replaced with aircraft of the " Continador " class. Under the conditions given here, it becomes almost impossible to retire any one of the aircraft from service, although they would have to fly less hours



Fuel costs per flight increase considerably with aircraft size and speed, but not in the same measure as the number of passenger seats ; on a per-passenger basis, therefore, they are lower for the two new types than for the DC-3, but nearly as high for the " Continador " as for the " Scalas."

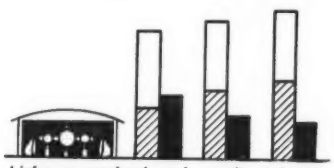


Oil costs increase in proportion to engine power and flight duration, hence increasing less per flight than per flight-hour ; economy per passenger, compared with the DC-3, is not great.

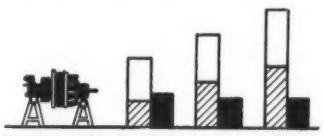


Airframe depreciation, per hour, does not increase so strongly (because of the longer life of the aircraft) as the price of the aircraft. Referred to a flight and compared with the DC-3, this increase is completely offset by the shorter trip duration with the " Scalas " and only partly in the case of the " Continador. "

Engine depreciation per flight-hour increases with the size (and price) of the engines ; these costs increase in the same manner per flight. Per-passenger share is just as high for the " Continador " as for the " Scalas. "



Airframe overhaul and repair costs per hour are computed according to the size, weight and price of the aircraft, and are therefore higher in the case of the new types. Costs per flight are not offset by the increased speed, but the costs per passenger decrease in view of the larger number of passengers.



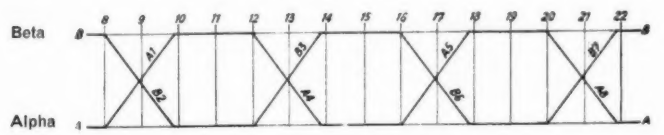
Engine overhaul and repair costs per flight-hour are governed by the weight, number of cylinders and price of the engines. Like the costs per flight, they are higher for the new types ; in the case of the " Continador " (18-cylinder engines !) they are equal, on a per-passenger basis, to those incurred by the " Scalas " (14-cylinder engines—same as the DC-3).

daily over the present route than the " Scalas " or the average of the DC-3s. Let us establish how many " Continadors " would be necessary, and then draw up a timetable.

Their seating accommodation for 40 passengers requires only four round trips daily. As each of these aircraft, on a basis of the average daily utilisation of seven and a half hours, can just make four one-way flights, only two aircraft are necessary, and these could be operated according to the following schedule :

ABECEDAIR — " Continador "

A1	B3	A5	B7		B2	A4	B6	A8
08 00	12 00	16 00	20 00	dep. Alpha arr.	09 52	13 52	17 52	21 52
09 52	13 52	17 52	21 52	arr. Beta dep.	08 00	12 00	16 00	20 00



Graphic presentation of the schedule operated with two " Continador " airliners A and B.

The smaller number and shorter duration of the flights make it very easy to arrange the times of departure in accordance with passengers' habits ; likewise, a late arrival of an aircraft no longer has any effect on the time of departure of the subsequent flight. On the other hand, it is impossible to retire one of the two aircraft from service, unless the other aircraft were to be operated 15 hours a day, *i.e.* from 6.30 a.m. to 11.30 p.m., without interruption and with waiting times of only half an hour at Alpha and Beta. Operations of this sort, however, could not even be maintained over the period required for overhauling the other aircraft, since it would not leave enough time for the most essential controls. Be as it may, the full utilisation of each aircraft, counting seven and a half hours daily (or 15 hours averaged through two days) on 365 days a year, would amount to 2,737.5 hours annually, instead of our basic figure of 2,433 hours. In order to reach this number, Abecedair would absolutely have to acquire a reserve aircraft for about 40.5 days per year per aircraft operated, thus for a total of about 81 days annually, or take an aircraft off some other line, for instance a route flown only during a certain season. The foregoing examination of operating costs is based on this assumption.

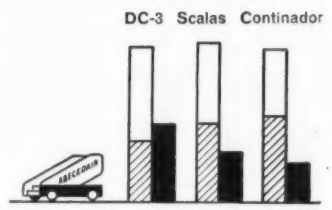
It goes without saying that this schedule will be thrown completely out of gear if one of the two aircraft unexpectedly became inoperable. If the company flies only this one route, then it will not have to hesitate about the costs of a third aircraft.

Comparison of Operating Costs

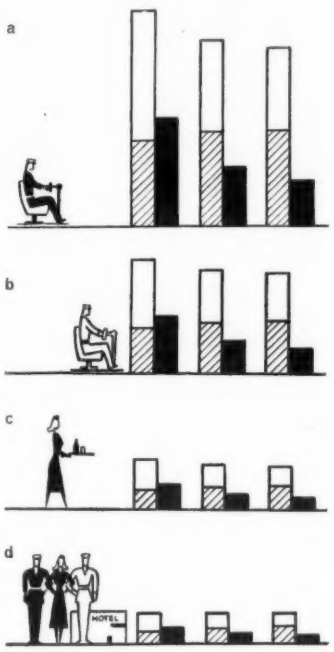
The desire to provide passengers with more favourable schedules and render operations more flexible is not the most decisive factor leading up to a choice of larger and faster airliners. On the contrary, the best way to reach this goal would be to have a large number of fast but smaller aircraft, in order to carry out as many flights as possible and keep plenty of aircraft in reserve at all the airports along the network.

The reason for re-organising flying equipment in this manner really lies in the operating costs, since these and, in consequence, the fares must decrease if the anticipated number of passengers is to be reached and maintained. The operating costs are constituted by a group of items, some very small, each of which is influenced in a different way by the size and by the speed of the aircraft (cf. table and graphic presentations).

Increased speed has a favourable influence above all on the part of the " fixed " costs attributable to each flight, such as airframe depreciation, fixed annual wages and insurance, because it enables the more or less constant annual total of these costs to be distributed over a larger number of flights, although the total number of flight-hours remains the same. Furthermore, the variable costs which



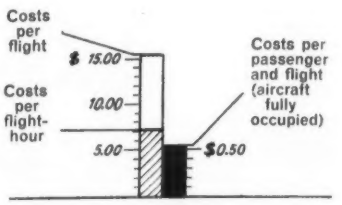
Ground service costs (controls, cleaning, filling-up, etc.) remain about the same per flight, although computed per flight hour and based on the weight of the aircraft. The amount per passenger decreases as the number of seats increases.



Pilot (a), co-pilot (b) and air hostess (c) earnings are constituted by a fixed annual wage and an hourly supplement graded according to speed. They therefore amount to more in the case of the new aircraft than for the DC-3 but incur—without penalising the personnel—lower costs per flight and much lower costs per passenger. Insurance premiums are included. There must be added an *expense supplement (d)*, calculated according to the trip length and therefore remaining the same for each flight, of which a smaller part is attributable to the passenger on the larger aircraft.

Aircraft insurance costs per flight-hour are higher for the new, larger airliners than for the DC-3, the difference being offset only by the " Scalas " thanks to the shorter flight duration. The share per passenger of these costs is the same for both new types, and much lower than for the DC-3.

Liability insurance premium is low and remains the same per flight for all types.



Comparison of different items of operating costs per Alpha-Beta flight and per passenger for DC-3, " Scalas " and " Continador " airliners. See next page for numerical tables and graphic comparison of total direct operating costs.

depend directly on the number of hours flown and disappear when the aircraft is not being operated—engine depreciation, overhauls, repairs and ground service—amount to less for a given trip length if the aircraft flies faster. On the other hand, the higher flying speed requires more powerful and complicated power plants, thus giving rise to increased fuel and oil consumption as well as greater depreciation and overhaul costs, which are only partly offset by the better performance.

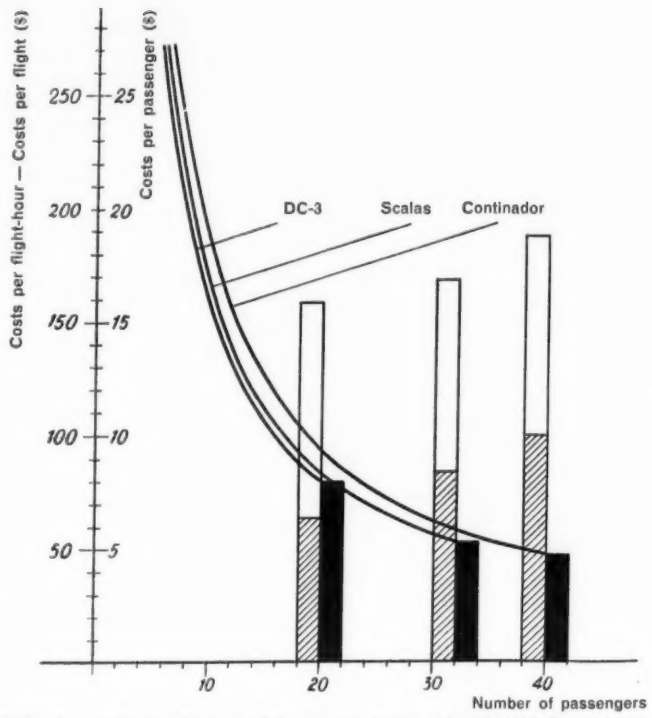
A larger number of passenger seats most of all calls for a larger and consequently heavier aircraft, and of course, still more powerful engines. This means a further increase in fuel and oil expenses, engine depreciation and overhaul costs ; furthermore, an increase in the expenses directly depending on the aircraft size, namely, airframe depreciation and overhaul, ground servicing and insurance of the entire aircraft.

Two small items, crew trip expenses and the liability insurance premium, which are customarily computed according to the number of miles flown, remain uninfluenced by changes in aircraft size and speed.

" Scalas " and " Continador " airliners differ from the DC-3 as regards both size and speed. Consequently, favourable and unfavourable influences, which are due to these differences, introduce themselves into the cost computation for each flight in an extremely unclear manner. In general, we can only ascertain that those costs for which only the size causes an increase, are about 20 to 30 per cent. higher for the " Continador " than for the DC-3, whereas the items which both the size and the speed cause to increase, reveal differences of 35 to 70 per cent.

The addition of all these items (cf. table) reveals the following : each flight with a " Scalas " airliner costs very little more than with a DC-3, namely about six per cent. more. Even with a " Continador, " the total costs per flight amount to only 18.5 per cent. more than with a DC-3. The fact that these costs are not considerably more is thanks to the higher cruising speed and shorter flight duration achieved with the new airliners ; a glance at the first three columns of the table reveals that the flight-hour with the " Scalas " costs 33 per cent. more than with the DC-3, and with the " Continador " even 68 per cent. more.

However, the commercial advantages offered by the larger aircraft cannot be fully appreciated until the costs per passenger transported have been considered. The result is clear enough : *If the aircraft is fully occupied, it costs Abecedair one third less to transport a passenger from Alpha to Beta with a " Scalas " than with a DC-3, and 41 per cent. less if the company acquires " Continador " airliners.*



Total direct operating costs (sum of the separate items—reduced scale). Curves show the modification of the operating costs per passenger when the aircraft is only partly occupied.

Direct operating cost per flight-hour, per Alpha-Beta flight and per passenger, using DC-3, " Scalas " and " Continador " airliners, computed by the ATA Method (cf. " INTERAVIA, Review of World Aviation, " Vol. II, No. 11, pp, 27-36).

	Costs ($) per flight-hour			Costs ($) per flight			Costs ($) per passenger and flight		
	DC-3	Scalas	Continador	DC-3	Scalas	Continador	DC-3	Scalas	Continador
Fuel :									
Gasoline	16.00	24.75	31.45	40.00	49.50	59.00	2.00	1.54	1.47
Oil	0.90	1.20	1.75	2.25	2.45	3.25	0.11	0.08	0.08
Total	**16.90**	**25.95**	**33 20**	**42.25**	**51.90**	**62.25**	**2.11**	**1.62**	**1.55**
Depreciation :									
Airframe	7.40	9.10	11.80	18.50	18.20	22.10	0.92	0.57	0.55
Engine	2.00	2.65	3.60	5.00	5.30	6.75	0.25	0.165	0.17
Total	**9.40**	**11.75**	**15.40**	**23.50**	**23.50**	**28.85**	**1.17**	**0.735**	**0 72**
Maintenance :									
Overhaul :									
Airframe	5.60	7.55	8.75	14.00	15.10	16.40	0.70	0.47	0.41
Engine	3.05	5.20	6.90	7.60	10.40	12.95	0.38	0.325	0.325
Ground service	6.85	8.90	9.10	17.15	17.80	17.05	0.86	0.56	0.425
Total	**15.50**	**21.65**	**24.75**	**38.75**	**43 30**	**46.40**	**1.94**	**1.355**	**1.16**
Personnel costs :									
Pilot	9.50	10.30	10.55	23.75	20.60	19.80	1.19	0.645	0.495
Co-pilot	5.00	5.65	5.85	12.50	11.30	11.00	0.62	0.355	0.275
Air hostess	2.15	2.45	2.55	5.40	4.90	4.80	0.27	0.155	0.12
Trip expenses	1.35	1.70	1.80	3.35	3.35	3.35	0.17	0.105	0.08
Total	**18.00**	**20.10**	**20.75**	**45.00**	**40.25**	**38.90**	**2.25**	**1.26**	**0.97**
Insurance :									
Aircraft	3.65	4.65	6.20	9.10	9.30	11.60	0.45	0.29	0.29
Liability	0.20	0.30	0.30	0.55	0.55	0.55	0.03	0.02	0.02
Total	**3.85**	**4.95**	**6.50**	**9.65**	**9.85**	**12.15**	**0.48**	**0.31**	**0.31**
Total operating costs	**63.65**	**84.40**	**100.60**	**159.15**	**168.80**	**188.55**	**7.95**	**5 28**	**4.71**
ditto with only 70% load	—	—	—	—	—	—	11.35	7.65	6.75

Are we therefore to assume that, as from January 1st, 1949, all fares over continental routes throughout the world will be reduced by 33 to 41 per cent. ? Unfortunately , no. What we have worked out here are only the direct operating costs, incurred by the flight and the flying equipment. There exist, in addition to these, the so-called overhead expenses of the airline company.

During the two-year period from April 1st, 1946, to March 31st, 1948, for which it is safe to assume that the majority of scheduled services were flown with DC-3s, 70 per cent. of the seats offered on U.S. domestic routes were utilised. If, with this aircraft and accommodation percentage, the direct operating costs for each passenger transported 420 miles work out at $11.35, as in the table, then the following overhead expenses should be added for the period under consideration, according to official U.S. statistics :

Operation of ground facilities	$4.20
Maintenance of ground facilities	2.35
Depreciation of ground facilities	0.45
Amenities for passengers	2.15
Ticket sales and clearance	3.25
Public relations	0.70
General administration	2.25
Total overhead expenses	$15.35

Abecedair is faced with the sad duty of having to add these costs, too, on to the costs of transporting each passenger. They may have dropped somewhat in the meantime, but they will surely not be modified to any great extent because the company acquires other types of airliner. Meanwhile, by adding together the direct operating and the overhead costs, we obtain the following Abecedair fares for one-way flights from Alpha to Beta :

With Douglas DC–3	$26.70
With " Scalas "	23.00
With " Continador "	22.10

Let us consult the latest air guide and turn to the part where the fares are indicated : first the " A's "—Aberdeen ... Albuquerque ... Alpha ; and now the " B's "—Baltimore ... Benbecula ... here it is ... Beta : $25.60. No wonder that Abecedair is losing money. But that will soon improve ... *T.*

The Different Ways of Compensating Torque in Helicopters

By Walter JUST, D.Sc.

A glance through the developmental history of the conventional aeroplane brings to light a great variety of designs : monoplanes, biplanes, triplanes, with and without wire or strut bracings, and so forth. Ultimately the cantilever monoplane proved to be the only suitable solution, with the result that it has today been adopted as the standard design.

As regards the construction of rotary-wing aircraft, we are today faced by a great number of different designs. However, it may safely be assumed that their development will also proceed in such a manner that only a few designs will find general introduction, and that these will continually be improved in the course of time. Three different types of rotary-wing aircraft can be distinguished : helicopters, autogyros and roto:-propeller aircraft.

Helicopter : A helicopter has one or more horizontal propellers, known as rotors, which are charged with providing the necessary lift which, in steady flight, must be equal to the gross weight. In forward flight, the drag furnished by the fuselage, tail assembly, superstructures, etc., is overcome by tilting the rotor or rotors a little forwards, thus producing a thrust component which is directed forwards and overcomes the drag. The rotors are mostly driven by the engine via a gear arrangement. The moment transferred by the engine to the large and relatively slowly-rotating rotor is very considerable ; in the case of a rotor of 12 metres diameter, which would go with a helicopter of about 1,500 kgs. gross weight, it amounts to approximately 1,000 metre-kilogrammes. This torque moment is of course supported by the fuselage, giving a reaction torque moment to the fuselage, and would rotate it in the opposite direction if it were not compensated by a second torque moment. Unless the torque moments are completely cancelled out, it is of course absolutely impossible to fly. There are a great number of methods of achieving this torque compensation. All the different constructions these involve —about sixteen manners of torque compensation can be differentiated—appear confusing to the amateur aeronautical engineer. To clarify the picture, therefore, we are giving below, in brief, the constructional principles, the advantages and disadvantages, etc., of the different methods.

Autogyro : An autogyro, which possesses a conventional tractor propeller in addition to a rotor, requires no torque compensation. Only the tractor propeller is driven, as in an ordinary aeroplane, by the engine,whereas the rotor, after having been spun to a certain r.p.m. by a special procedure, is maintained in rotation by the relative wind alone. The tractor propeller overcomes all drag furnished by the fuselage, tail assembly, superstructures, and also the rotor, the latter's drag being very considerable. The autogyro was perfected long before the helicopter (the name was patented by de la Cierva for his invention), but is no longer of very great interest today. By a special take-off method, the so-called " jump take-off," the autogyro can nevertheless take off vertically. But it is unable to hover in the air and land vertically like a helicopter.

Rotor-Propeller Aircraft : Similar to the autogyro it has one or more rotors and a tractor propeller. However, it differs from the autogyro by having not only the tractor propeller driven by the engine, but also the rotor. There is a possibility of varying between wide limits the distribution of the entire engine power between the propeller and the rotor(s). Helicopters and autogyros, therefore, represent the limit variations of this type of aircraft. The rotor-propeller aircraft has properties which are similar to those of a helicopter, and under certain circumstances is superior to a helicopter in horizontal flight. As the rotor is also driven by the engine, it is of course necessary to devise a means of compensating torque in the rotor-propeller aircraft.

Torque-Compensation Methods

Different methods are suitable for compensating torque moments, and these have a considerable influence on the external aspects and the construction of a rotary-wing aircraft. The following principles may be differentiated (cf. Fig. 1) :-

a. Rotor pairs turning in opposite directions (Nos. 1, 2, 4, 5, 6 and 7).
b. Rotors turning in the same direction, but on tilted shafts (Nos. 3 and 8).
c. Direct drive of the rotor blades, eliminating the necessity for torque compensation (Nos. 9, 10 and 11).
d. Rotor with auxiliary propeller or auxiliary jet stream (Nos. 12, 13 and 14).
e. Rotors and stabilising surfaces (Nos 15 and 16).

The level so far attained in the domain of rotary-wing aircraft engineering is such that it is easy to indicate the torque-compensation methods that are to be regarded as particularly disadvantageous, but it is by no means easy to find the best solution, since too many factors play a simultaneous rôle : flight performance (*e.g.* cruising speed, lifting capacity, etc.), flight characteristics (problems of stability and control), safety aspects, and so forth. It frequently happens that a special method of torque compensation is particularly suitable in a specific case. It is often only after carefully grouping all aerodynamic, weight and constructional losses and gains that the designer can make his final decision on a particular principle of torque-compensation. The various ways of achieving torque-compensation are given in Fig. 1, and we shall now broadly outline their advantages and disadvantages.

Four and Three Rotors

No. 1 : This configuration, with one pair of rotors on either side of the fuselage, was chosen in 1905 by Dufaux for his model helicopter. It is unnecessarily complicated and presents no special advantages, so that we shall refrain from examining this principle further. No modern helicopter is designed along these lines.

No. 2 : This design, likewise featuring four rotors, was first applied by the Bréguet brothers, acknowledged to have been the first to build a helicopter, in 1907, able to rise from the ground with one man on board (Fig. 2).

This principle was later used by Von Bothezat and Oehmichen, and recently by Florine (Belgium) for a small helicopter. By means of a relatively simple adjustment of a pair of rotors, longitudinal and lateral

depend directly on the number of hours flown and disappear when the aircraft is not being operated—engine depreciation, overhauls, repairs and ground service—amount to less for a given trip length if the aircraft flies faster. On the other hand, the higher flying speed requires more powerful and complicated power plants, thus giving rise to increased fuel and oil consumption as well as greater depreciation and overhaul costs, which are only partly offset by the better performance.

A larger number of passenger seats most of all calls for a larger and consequently heavier aircraft, and of course, still more powerful engines. This means a further increase in fuel and oil expenses, engine depreciation and overhaul costs ; furthermore, an increase in the expenses directly depending on the aircraft size, namely, airframe depreciation and overhaul, ground servicing and insurance of the entire aircraft.

Two small items, crew trip expenses and the liability insurance premium, which are customarily computed according to the number of miles flown, remain uninfluenced by changes in aircraft size and speed.

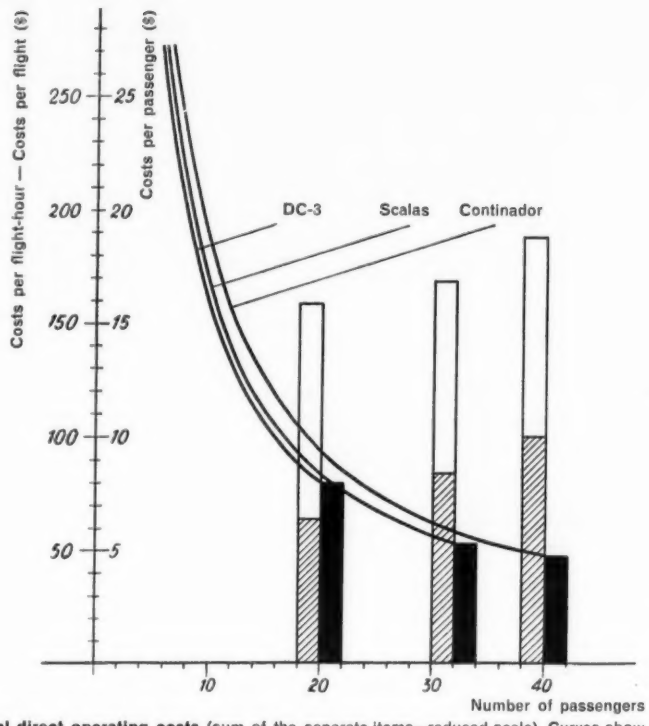
" Scalas " and " Continador " airliners differ from the DC-3 as regards both size and speed. Consequently, favourable and unfavourable influences, which are due to these differences, introduce themselves into the cost computation for each flight in an extremely unclear manner. In general, we can only ascertain that those costs for which only the size causes an increase, are about 20 to 30 per cent. higher for the " Continador " than for the DC-3, whereas the items which both the size and the speed cause to increase, reveal differences of 35 to 70 per cent.

The addition of all these items (cf. table) reveals the following : each flight with a " Scalas " airliner costs very little more than with a DC-3, namely about six per cent. more. Even with a " Continador, " the total costs per flight amount to only 18.5 per cent. more than with a DC-3. The fact that these costs are not considerably more is thanks to the higher cruising speed and shorter flight duration achieved with the new airliners ; a glance at the first three columns of the table reveals that the flight-hour with the " Scalas " costs 33 per cent. more than with the DC-3, and with the " Continador " even 68 per cent. more.

However, the commercial advantages offered by the larger aircraft cannot be fully appreciated until the costs per passenger transported have been considered. The result is clear enough : *If the aircraft is fully occupied, it costs Abecedair one third less to transport a passenger from Alpha to Beta with a " Scalas " than with a DC-3, and 41 per cent. less if the company acquires " Continador " airliners.*

Direct operating cost per flight-hour, per Alpha-Beta flight and per passenger, using DC-3, " Scalas " and " Continador " airliners, computed by the ATA Method (cf. " INTERAVIA, Review of World Aviation, " Vol. II, No. 11, pp, 27-36).

	Costs ($) per flight-hour			Costs ($) per flight			Costs ($) per passenger and flight		
	DC-3	Scalas	Continador	DC-3	Scalas	Continador	DC-3	Scalas	Continador
Fuel :									
Gasoline	16.00	24.75	31.45	40.00	49.50	59.00	2.00	1.54	1.47
Oil	0.90	1.20	1.75	2.25	2.45	3.25	0.11	0.08	0.08
Total	**16.90**	**25.95**	**33 20**	**42.25**	**51.90**	**62.25**	**2.11**	**1.62**	**1.55**
Depreciation :									
Airframe	7.40	9.10	11.80	18.50	18.20	22.10	0.92	0.57	0.55
Engine	2.00	2.65	3.60	5.00	5.30	6.75	0.25	0.165	0.17
Total	**9.40**	**11.75**	**15.40**	**23.50**	**23.50**	**28.85**	**1.17**	**0.735**	**0 72**
Maintenance :									
Overhaul :									
Airframe	5.60	7.55	8.75	14.00	15.10	16.40	0.70	0.47	0.41
Engine	3.05	5.20	6.90	7.60	10.40	12.95	0.38	0.325	0.325
Ground service	6.85	8.90	9.10	17.15	17.80	17.05	0.86	0.56	0.425
Total	**15.50**	**21.65**	**24.75**	**38.75**	**43 30**	**46.40**	**1.94**	**1.355**	**1.16**
Personnel costs :									
Pilot	9.50	10.30	10.55	23.75	20.60	19.80	1.19	0.645	0.495
Co-pilot	5.00	5.65	5.85	12.50	11.30	11.00	0.62	0.355	0.275
Air hostess	2.15	2.45	2.55	5.40	4.90	4.80	0.27	0.155	0.12
Trip expenses	1.35	1.70	1.80	3.35	3.35	3.35	0.17	0.105	0.08
Total	**18.00**	**20.10**	**20.75**	**45.00**	**40.25**	**38.90**	**2.25**	**1.26**	**0.97**
Insurance :									
Aircraft	3.65	4.65	6.20	9.10	9.30	11.60	0.45	0.29	0.29
Liability	0.20	0.30	0.30	0.55	0.55	0.55	0.03	0.02	0.02
Total	**3.85**	**4.95**	**6.50**	**9.65**	**9.85**	**12.15**	**0.48**	**0.31**	**0.31**
Total operating costs	**63.65**	**84.40**	**100.60**	**159.15**	**168.80**	**188.55**	**7.95**	**5 28**	**4.71**
ditto with only 70% load	—	—	—	—	—	—	11.35	7.65	6.75



Total direct operating costs (sum of the separate items—reduced scale). Curves show the modification of the operating costs per passenger when the aircraft is only partly occupied.

Are we therefore to assume that, as from January 1st, 1949, all fares over continental routes throughout the world will be reduced by 33 to 41 per cent. ? Unfortunately , no. What we have worked out here are only the direct operating costs, incurred by the flight and the flying equipment. There exist, in addition to these, the so-called overhead expenses of the airline company.

During the two-year period from April 1st, 1946, to March 31st, 1948, for which it is safe to assume that the majority of scheduled services were flown with DC-3s, 70 per cent. of the seats offered on U.S. domestic routes were utilised. If, with this aircraft and accommodation percentage, the direct operating costs for each passenger transported 420 miles work out at $11.35, as in the table, then the following overhead expenses should be added for the period under consideration, according to official U.S. statistics :

Operation of ground facilities	$4.20
Maintenance of ground facilities	2.35
Depreciation of ground facilities	0.45
Amenities for passengers	2.15
Ticket sales and clearance	3.25
Public relations	0.70
General administration	2.25
Total overhead expenses	$15.35

Abecedair is faced with the sad duty of having to add these costs, too, on to the costs of transporting each passenger. They may have dropped somewhat in the meantime, but they will surely not be modified to any great extent because the company acquires other types of airliner. Meanwhile, by adding together the direct operating and the overhead costs, we obtain the following Abecedair fares for one-way flights from Alpha to Beta :

With Douglas DC–3	$26.70
With " Scalas "	23.00
With " Continador "	22.10

Let us consult the latest air guide and turn to the part where the fares are indicated : first the " A's "—Aberdeen ... Albuquerque ... Alpha ; and now the " B's "—Baltimore ... Benbecula ... here it is ... Beta : $25.60. No wonder that Abecedair is losing money. But that will soon improve ... *T.*

The Different Ways of Compensating Torque in Helicopters

By Walter JUST, D.Sc.

A glance through the developmental history of the conventional aeroplane brings to light a great variety of designs : monoplanes, biplanes, triplanes, with and without wire or strut bracings, and so forth. Ultimately the cantilever monoplane proved to be the only suitable solution, with the result that it has today been adopted as the standard design.

As regards the construction of rotary-wing aircraft, we are today faced by a great number of different designs. However, it may safely be assumed that their development will also proceed in such a manner that only a few designs will find general introduction, and that these will continually be improved in the course of time. Three different types of rotary-wing aircraft can be distinguished : helicopters, autogyros and roto:-p:opeller aircraft.

Helicopter : A helicopter has one or more horizontal propellers, known as rotors, which are charged with providing the necessary lift which, in steady flight, must be equal to the gross weight. In forward flight, the drag furnished by the fuselage, tail assembly, superstructures, etc., is overcome by tilting the rotor or rotors a little forwards, thus producing a thrust component which is directed forwards and overcomes the drag. The rotors are mostly driven by the engine via a gear arrangement. The moment transferred by the engine to the large and relatively slowly-rotating rotor is very considerable ; in the case of a rotor of 12 metres diameter, which would go with a helicopter of about 1,500 kgs. gross weight, it amounts to approximately 1,000 metre-kilogrammes. This torque moment is of course supported by the fuselage, giving a reaction torque moment to the fuselage, and would rotate it in the opposite direction if it were not compensated by a second torque moment. Unless the torque moments are completely cancelled out, it is of course absolutely impossible to fly. There are a great number of methods of achieving this torque compensation. All the different constructions these involve —about sixteen manners of torque compensation can be differentiated—appear confusing to the amateur aeronautical engineer. To clarify the picture, therefore, we are giving below, in brief, the constructional principles, the advantages and disadvantages, etc., of the different methods.

Autogyro : An autogyro, which possesses a conventional tractor propeller in addition to a rotor, requires no torque compensation. Only the tractor propeller is driven, as in an ordinary aeroplane, by the engine,whereas the rotor, after having been spun to a certain r.p.m. by a special procedure, is maintained in rotation by the relative wind alone. The tractor propeller overcomes all drag furnished by the fuselage, tail assembly, superstructures, and also the rotor, the latter's drag being very considerable. The autogyro was perfected long before the helicopter (the name was patented by de la Cierva for his invention), but is no longer of very great interest today. By a special take-off method, the so-called " jump take-off," the autogyro can nevertheless take off vertically. But it is unable to hover in the air and land vertically like a helicopter.

Rotor-Propeller Aircraft : Similar to the autogyro it has one or more rotors and a tractor propeller. However, it differs from the autogyro by having not only the tractor propeller driven by the engine, but also the rotor. There is a possibility of varying between wide limits the distribution of the entire engine power between the propeller and the rotor(s). Helicopters and autogyros, therefore, represent the limit variations of this type of aircraft. The rotor-propeller aircraft has properties which are similar to those of a helicopter, and under certain circumstances is superior to a helicopter in horizontal flight. As the rotor is also driven by the engine, it is of course necessary to devise a means of compensating torque in the rotor-propeller aircraft.

Torque-Compensation Methods

Different methods are suitable for compensating torque moments, and these have a considerable influence on the external aspects and the construction of a rotary-wing aircraft. The following principles may be differentiated (cf. Fig. 1) :-

a. Rotor pairs turning in opposite directions (Nos. 1, 2, 4, 5, 6 and 7).
b. Rotors turning in the same direction, but on tilted shafts (Nos. 3 and 8).
c. Direct drive of the rotor blades, eliminating the necessity for torque compensation (Nos. 9, 10 and 11).
d. Rotor with auxiliary propeller or auxiliary jet stream (Nos. 12, 13 and 14).
e. Rotors and stabilising surfaces (Nos 15 and 16).

The level so far attained in the domain of rotary-wing aircraft engineering is such that it is easy to indicate the torque-compensation methods that are to be regarded as particularly disadvantageous, but it is by no means easy to find the best solution, since too many factors play a simultaneous rôle : flight performance (*e.g.* cruising speed, lifting capacity, etc.), flight characteristics (problems of stability and control), safety aspects, and so forth. It frequently happens that a special method of torque compensation is particularly suitable in a specific case. It is often only after carefully grouping all aerodynamic, weight and constructional losses and gains that the designer can make his final decision on a particular principle of torque-compensation. The various ways of achieving torque-compensation are given in Fig. 1, and we shall now broadly outline their advantages and disadvantages.

Four and Three Rotors

No. 1 : This configuration, with one pair of rotors on either side of the fuselage, was chosen in 1905 by Dufaux for his model helicopter. It is unnecessarily complicated and presents no special advantages, so that we shall refrain from examining this principle further. No modern helicopter is designed along these lines.

No. 2 : This design, likewise featuring four rotors, was first applied by the Bréguet brothers, acknowledged to have been the first to build a helicopter, in 1907, able to rise from the ground with one man on board (Fig. 2).

This principle was later used by Von Bothezat and Oehmichen, and recently by Florine (Belgium) for a small helicopter. By means of a relatively simple adjustment of a pair of rotors, longitudinal and lateral

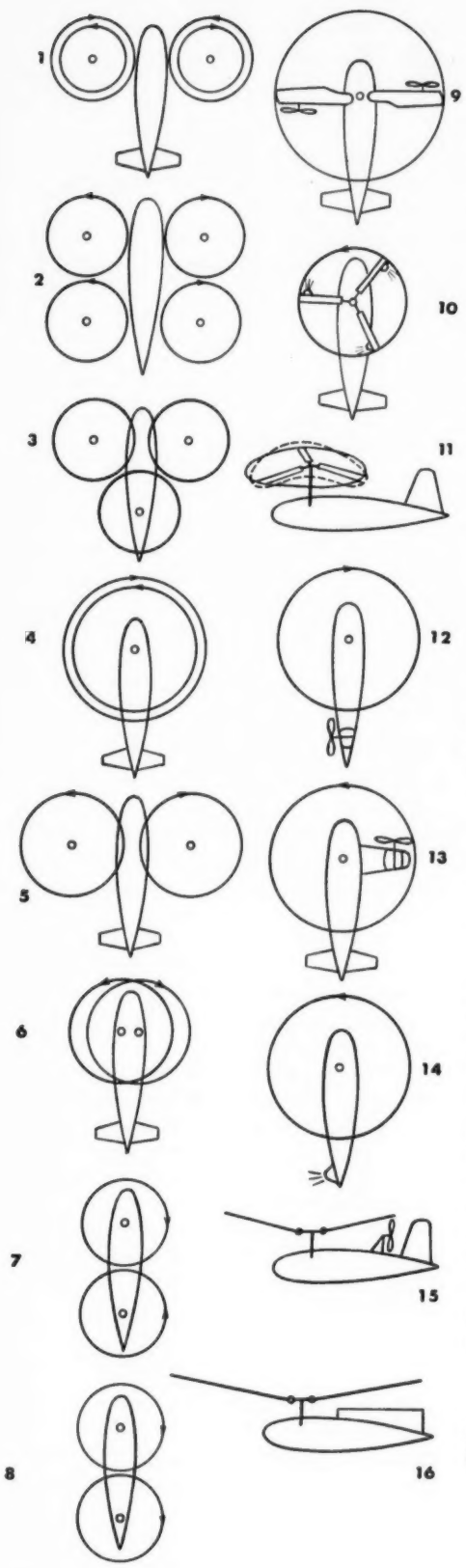


Fig. 1: Different torque-compensation methods.

control can easily be achieved with this construction. Longitudinal control with the control column pushed forwards, thus in order to attain a nose-heavy moment, results when the angle of blade pitch of the two rear rotors is increased somewhat and decreased for the front rotors. Conversely, the longitudinal and lateral control for a single-rotor helicopter, as well as the longitudinal control for construction No. 5, etc., is considerably more complicated. In addition to the constant angle of pitch of about $\theta_{r.} = 12$ deg., the blade must be subjected to a cyclic pitch-change procedure, according to $\theta_s \cdot \sin \psi$ for the longitudinal control and $\theta_c \cdot \cos \psi$ for the lateral control.[1]

It is clear that a cyclic pitch-change procedure will require a considerably more complicated mechanism in the rotor head than a collective pitch-change principle. A marked advantage of construction No. 2 is therefore its simplicity.

It is a known fact that helicopters with one and two rotors, when hovering or flying at low speeds, feature dynamic instability, *i.e.* the aircraft has a tendency, when the control column is grasped firmly, to produce incremental oscillations — about the lateral axis y and also the longitudinal axis x in the case of single-rotor helicopters. In a twin-rotor construction, with the rotors not positioned one on top of the other, thus as shown in Nos. 5, 7 and 8, however, dynamic instability only occurs about one axis; in the case of No. 5 it is about the lateral axis y, and for Nos. 7 and 8 about the longitudinal axis x.[1] In the case of No. 5, for instance, during the rotation about the longitudinal axis x, as a result of the rotors lying far apart, there arises a certain damping moment, rather similar to the damping of the rolling moment in conventional aeroplanes. The same applies to the rotation about the lateral axis y in the case of Nos. 7 and 8. If the rotors are located far enough apart, the damping can be large enough to prevent dynamic instability occurring about the axis in question.

As can be seen, construction No. 2 is especially advantageous in this respect, since a certain damping moment about the lateral and longitudinal axes occurs. This also applies to construction No. 3 with three rotors. In any case, this damping moment will decrease the incremental tendency of the dynamic instability. It will depend on the particular constructional and other conditions whether this damping suffices to produce dynamic stability, thus a fading out of disturbances.

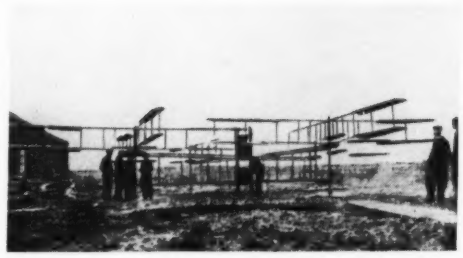


Fig. 2: Helicopter built in 1907 by the Bréguet brothers, which was the first machine of its kind to rise from the ground with one man on board.

During hovering flight in ground vicinity, however, the contrary can arise, *i.e.* that a single rotor helicopter is easier to fly than a multi-rotor design. Let us consider, for example, construction No. 5. During hovering flight at a great distance from the ground, there arises a certain damping about the longitudinal axis x. Assuming the helicopter to be near to the ground, having tilted a little to port because of a disturbance, so that the port rotor is a little nearer to the ground than the starboard one, the port rotor consequently furnishes more lift than the starboard one.[2] As a result, however, the aircraft will now be turned strongly towards the right, and then again to the left, and so on, so that in conjunction with other aerodynamic effects, a certain incremental tendency can arise, as was revealed by the aircraft types No. 5, the Focke-Wulfe Fw 61 and Focke-Achgelis Fa 223. We can therefore summarise by saying that, in hovering flight and at low speeds, the multi-rotor helicopters Nos. 2, 3, 5, 7 and 8 are easier to fly at great distances from the ground than single-rotor helicopters are, but for the especially critical flight stadium in ground vicinity, the single-rotor helicopter can prove even superior.

[1] Cf. W. Just: "Calculating the Longitudinal Stability and Control of Helicopters," Vol. II, No. 12. A printing error may be noted here. Only minus signs should occur throughout equations (1) and (28).

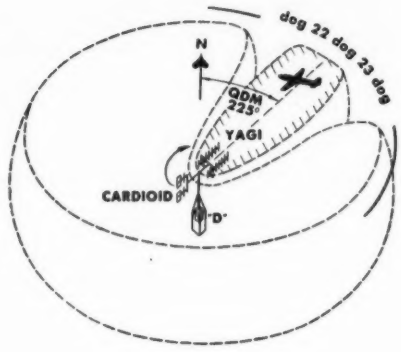
[2] Cf. W. Just: "Performance Calculation for Helicopters," Vol. II, Nos. 3 and 4.

(To be continued in the next issue)

A Short Guide to Radio Aids used in Air Navigation

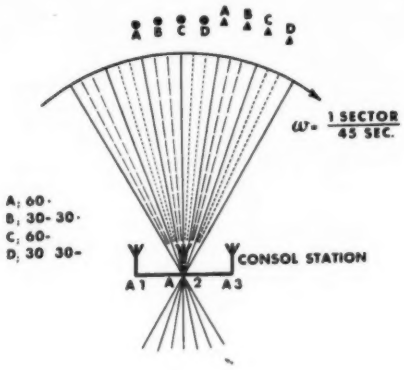
DIRECTIONAL RADIO BEACONS (Continued *)

6	NAVIGATION BY SHORT-RANGE MF AND VHF ROTATING BEACONS	RADIOPHARES TOURNANTS MF ET VHF POUR LA NAVIGATION A COURTES DISTANCES	RADIOFAROS GIRATORIOS MF Y VHF PARA LA NAVEGACIÓN A CORTA DISTANCIA	NAVIGATION NACH MF DREHBAKEN UND VHF SPRECHDREHBAKEN
	STANDARD MF ROTATING BEACONS	RADIOPHARE TOURNANT MF STANDARD	RADIOFARO GIRATORIO MF STANDARD	EINFACHE MF DREHBAKE
	SPEECH MODULATION	MODULATION EN PHONIE	MODULACIÓN EN FONÍA	SPRECHMODULATION
	YAGI BEAM ARRAY	FAISCEAU YAGI	HAZ YAGI	YAGI-STRAHLENBÜNDEL
	CARDIOID AERIAL	ANTENNE A CARACTÉRISTIQUE EN CARDIOIDE	ANTENA DE CARACTERÍSTICA EN CARDIOIDE	KARDIOIDANTENNE (DAUERTON)



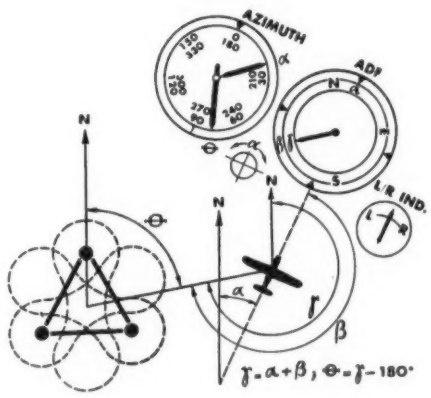
Navigating off airways with the aid of short-range rotating beacons, each emitting a slowly-rotating beam array, requires only standard airborne receivers. When the beam of an MF ROTATING BEACON passes through the north, a further signal is broadcast, the azimuth being derived from the time interval between receptions. VHF ROTATING BEACONS use revolving Yagi aerials to radiate, on a speech-modulated carrier, their characteristic call signal and the corresponding bearing ; simultaneously, a tone-modulated cardioid-shaped transmission gives the aircraft an indication of continuous beacon reception between periods of speech reception, removes ambiguities, and keeps the speech beam narrow ; course to beacon is derived from the mid-point of bearings heard. Range is 90 miles.

7	NAVIGATION BY LONG-RANGE "CONSOL" (MF)	SYSTÈME DE NAVIGATION A LONGUES DISTANCES CONSOL (MF)	SISTEMA DE NAVEGACIÓN A LARGA DISTANCIA CONSOL (MF)	MF LANGSTRECKEN-NAVIGATIONSSYSTEM "CONSOL" (SONNE)
	"CONSOL" COVER	CIRCONSCRIPTION CONSOL	CIRCUNSCRIPCIÓN CONSOL	CONSOL-BEREICH
	"CONSOL" CHART	CARTE CONSOL	MAPA CONSOL	CONSOL-RASTERKARTE
	DAY (NIGHT) RANGE	PORTÉE DE JOUR (DE NUIT)	ALCANCE DE DÍA (DE NOCHE)	TAGES- (NACHT-) REICHWEITE
	BEARING ERROR	ERREUR DE RELÈVEMENT	ERROR DE MARCACIÓN	AZIMUTFEHLER



When navigating over long distances, particularly over water, very exact azimuth determination is essential. MF "Consol" stations enable this to be achieved with the aid of standard airborne receivers, but the approximate position must first be known, or found from rough bearings taken by normal D/F loop (cf. 9). Three aligned aerials emit over two sectors 120 deg. wide and centred on the line normal to the aerials, dot and dash signals (morse E and T) on beams slowly swept by appropriate aerial switching, which are heard and counted on board the aircraft, thus enabling the azimuth to be obtained from tables or "Consol" charts. Over-water range, 1,000 miles by day and 1,500 by night ; day error is ± 0.2 to ± 1 deg., night error greater.

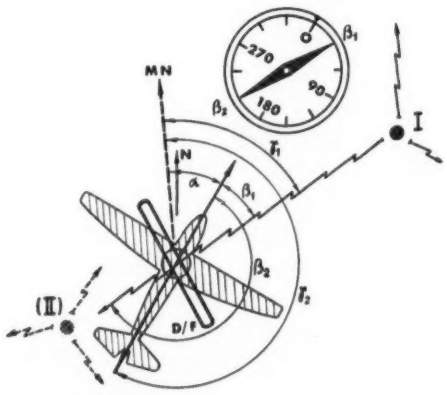
8	NAVIGATION BY LONG-RANGE "NAVAGLOBE" (LF)	SYSTÈME DE NAVIGATION A LONGUES DISTANCES "NAVAGLOBE" (LF)	SISTEMA DE NAVEGACIÓN A LARGA DISTANCIA "NAVAGLOBE" (LF)	LF LANGSTRECKEN-NAVIGATIONSSYSTEM "NAVAGLOBE"
	AZIMUTH METER (θ) (1 rev. = 180 deg. Az.)	AZIMUT-MÈTRE (θ) (1 tour = 180° en azimut)	AZIMUT-METRO (θ) (1 vuelta = 180° en azimut)	AZIMUTMESSER (θ) (1 Umdr. = 180° Az.)
	ADF METER (WITH COMPASS-COUPLED SCALE)	ADF-MÈTRE (AVEC ROSE ACCOUPLÉE)	ADF-METRO (CON ROSA ACOPLADA)	RADIOKOMPASS (MIT FERNKOMPASSROSE)
	PATH SELECTOR NEEDLE	AIGUILLE DE SÉLECTION DE CAP	AGUJA DE SELECCIÓN DE RUMBO	KURSWÄHLNADEL
	COURSE INDICATOR (LEFT-RIGHT INDICATOR)	INDICATEUR DE CAP (INDICATEUR GAUCHE-DROITE)	INDICADOR DE RUMBO (INDICADOR IZQUIERDA-DERECHA)	ZIELKURSANZEIGER (LINKS-RECHTS-ANZEIGER)



A projected world-wide navigational system providing about 75 LF stations distributed so as to bring every travelled portion of the globe within range of two stations. Each "Navaglobe" station has three directional aerials forming an equilateral triangle, together giving reception through 360 deg. and over a range of approximately 1,500 miles. Azimuth obtained by two different methods with aid of automatic devices (azimuth meter, ADF meter), thus providing reciprocal check. Can also be used to fly any range-leg, as adjustment of path selector needle results in fly-right or fly-left signals on the course indicator ; these signals can also be fed direct to an automatic-pilot device.

DIRECTION-FINDING

9	DIRECTION FINDING WITH D/F LOOP	RADIOGONIOMÈTRES D'AÉRONEFS (D/F)	RADIOGONIÓMETROS DE AERONAVES (D/F)	EIGENPEILUNG MIT PEILEMPFÄNGER
	AURAL NULL	EXTINCTION	EXTINCIÓN	MINIMALER HÖREMPFANG
	D/F LOOP	CADRE RADIOGONIOMÉTRIQUE	CUADRO RADIOGONIOMÉTRICO	PEILRAHMEN
	RELATIVE BEARING (β)	GISEMENT (β)	LOCALIZACIÓN (θ)	BORDSEITENPEIL-WINKEL (β)
	AIRCRAFT HEADING (α)	CAP DE L'AVION (α)	RUMBO DEL AVIÓN (α)	STEUERKURS (α)

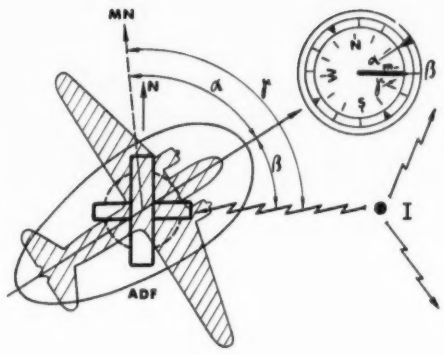


Airborne equipment comprises D/F loop aerial, rotatable through 360 deg., and a receiver. When the receiver is tuned to a ground station, and the loop set perpendicular to the station direction (null position), reception is at minimum or null volume (which is easier caught by the human ear than maximum). The bearing (β) relative to the longitudinal axis of the aircraft is read off a scale coupled with the loop. The angle (γ) between the magnetic (or true) north and the bearing line to the ground station is the sum of the relative bearing (β) and the aircraft heading (α) with respect to the magnetic (or true) north. Indications have 180-deg. ambiguity (hence double pointer) as the ground station can be at either point I or II.

* Cf. "Interavia, Review of World Aviation," Vol. III, No. 11, pp. 626-628.

10 DIRECTION-FINDING BY RADIO COMPASS OR AUTOMATIC RADIO COMPASS (ADF)

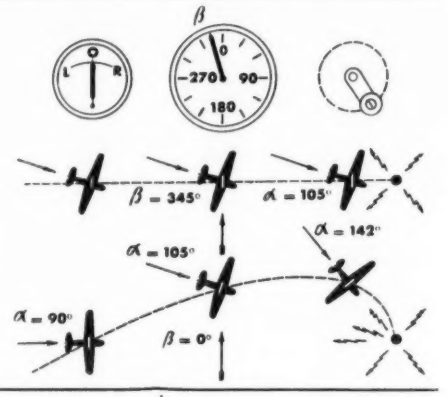
RADIOGONIOMÉTRIE PAR RADIO-COMPAS OU RADIO-COMPAS AUTOMATIQUE (ADF)	RADIOGONIOMETRÍA POR RADIO COMPÁS O RADIO-COMPÁS AUTOMÁTICO (ADF)	EIGENPEILUNG MIT RADIOKOMPASS ODER AUTOMATISCHEM RADIOKOMPASS
COMMANDE DU CADRE (DE L'ÉCHELLE)	MANDO POR MANIVELA DEL CUADRO	RAHMENKURBEL (UND SKALA)
COMMANDE AUTOMATIQUE DU CADRE	MANDO AUTOMÁTICO DEL CUADRO	AUTOMATISCHER RAHMENANTRIEB
CADRE SIMPLE (DOUBLE)	CUADRO SIMPLE (DOBLE)	EINFACH- (DOPPEL-) RAHMENAGGREGAT
ANTENNE AUXILIAIRE DE SENSIBILISATION	ANTENA AUXILIAR DE SENSIBILIZACIÓN	UNGERICHTETE HILFSANTENNE



The RADIO COMPASS provides an unidirectional bearing indication, whereby a sense aerial and a special receiver detect the direction of origin of the incoming wave, thus cancelling the 180-deg. ambiguity of the simple D/F loop system. The AUTOMATIC RADIO COMPASS has a powered rotating mechanism (in place of the simple loop crank) which automatically brings the loop to null position, irrespective of changes in aircraft heading. In models with dual loop assembly, an inner loop replaces the sense aerial ; located perpendicular to the main loop, it gives maximum volume of reception when the latter gives minimum. The ADF indicator has a fixed outer scale and a moveable inner scale, adjusted either manually or automatically to give the aircraft heading (α), thus directly indicating the angle (γ) between the bearing line and the north.

11 HOMING WITH D/F

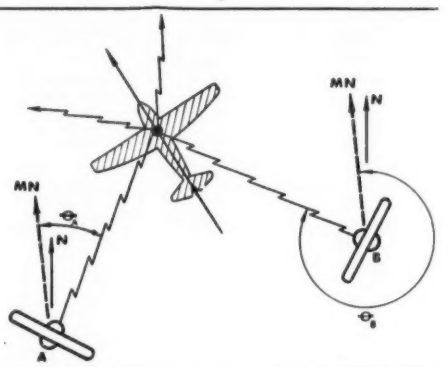
HOMING PAR RADIO-GONIOMÉTRIE	HOMING POR RADIO-GONIOMETRÍA	ZIELFLUG MIT EIGENPEILGERÄT
CADRE EN POSITION DE HOMING	CUADRO EN POSICIÓN DE HOMING	PEILRAHMEN IN ZIELFLUGLAGE
SANS CORRECTION DE LA DÉRIVE	CON CORRECCIÓN DE LA DERIVA	OHNE WIND-BERICHTIGUNG
AVEC CORRECTION DE LA DÉRIVE	SIN CORRECCIÓN DE LA DERIVA	MIT WIND-BERICHTIGUNG



When the D/F loop is set perpendicular to the aircraft's longitudinal axis and the aircraft is steered so that a null signal is always received, the aircraft is heading either to or from the station (QDM or QDR) along a track which is curved according to lateral-wind conditions. Off-course derivations are indicated as visual left-right signals and/or as aural A-N morse signals, or else transformed into pulses which are fed direct to an automatic-pilot device. To compensate drift, the loop can be brought slightly out of null position by setting the null pointer to the downwind side of the aircraft's nose.

12 GROUND DIRECTION-FINDING

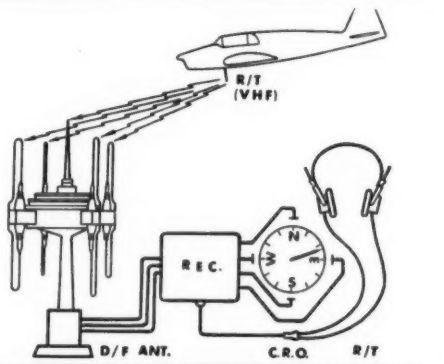
RADIOGONIOMÈTRES AU SOL	RADIOGONIÓMETROS EN TIERRA	EINFACHE FREMDPEILUNG
RELÈVEMENT MAGNÉTIQUE (QDR) OU VRAI (QTE)	MARCACIÓN MAGNÉTICA (QDM) O VERDADERA (QTE)	MISSWEISENDER (QDR) ODER RECHT-WEISENDER (QTE) PEILWINKEL
CAP DE HOMING MAGNÉTIQUE (QDM) OU VRAI (QUJ)	RUMBO DE HOMING MAGNÉTICO (QDM) O VERDADERO (QUJ)	MISSWEISENDER (QDM) OD. RECHTWEISENDER (QUJ) ZIELKURS
DISTANCE A... (QGE)	DISTANCIA A... (QGE)	ENTFERNUNG VON..(QGE)
POSITION (QTF)	POSICIÓN (QTF)	STANDORT (QTF)



At the aircraft's request, ground D/F receivers (e g. A and B) take bearings on the airborne transmitter (which has identified itself) by determining the angle between the bearing line and the magnetic (MN) or true (N) north, and radio these bearings back to the aircraft, thus enabling the fix to be plotted on board the aircraft. Alternatively, ground stations can plot the fix and radio it to the aircraft. International Q-code is used in communications.

13 GROUND VHF AUTOMATIC DIRECTION-FINDING

RADIOGONIOMÈTRES AU SOL AUTOMATIQUES VHF	RADIOGONIÓMETRO EN TIERRA AUTOMÁTICO VHF	AUTOMATISCHE VHF SPRECHFUNK-FREMDPEILUNG
OSCILLOSCOPE CATHODIQUE ; TUBE A RAYONS CATHODIQUES	OSCILOSCOPIO CATÓDICO ; TUBO DE RAYOS CATÓDICOS	KATHODENSTRAHLEN-RÖHRE (BRAUN'SCHE RÖHRE)
ANTENNE ADCOCK DE RADIOGONIOMÈTRE AVEC ANTENNE (CENTRALE DE SEN-)SIBILISATION	ANTENA ADCOCK DE RADIOGONIÓMETRO CON ANTENA (CENTRAL) DE SENSIBILIZACIÓN	ADCOCK-PEILANTENNE MIT (MITTLERER) FÜHLANTENNE

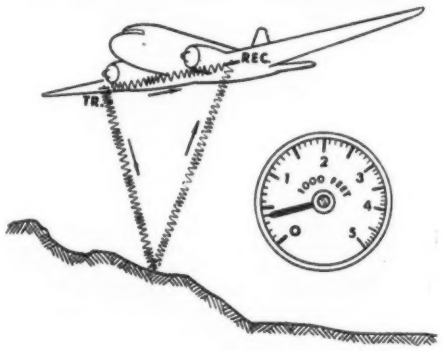


VHF voice transmissions from aircraft are received by aerodrome receivers equipped with fixed H-type Adcock aerial systems employing folded dipoles ; direction of incoming waves is continuously indicated on the scope of a cathode-ray tube. In this way QDM and QDR bearings can be radioed from the control tower without delay at the same time as the voice communications are maintained. Range up to 100 miles.

RADIOLOCATION

14 ALTITUDE DETERMINATION BY UHF RADIO ALTIMETER

RADIO-ALTIMÈTRES UHF	RADIO ALTÍMETRO UHF	HÖHENBESTIMMUNG DURCH UHF RADIOHÖHENMESSER
HAUTEUR AU-DESSUS DU SOL	ALTURA SOBRE EL SUELO	HÖHE ÜBER GRUND
FRÉQUENCEMÈTRE DIFFÉRENTIEL (INTERFEROMÈTRE)	FRECUENCIA METRO DIFERENCIAL (INTERFERÓMETRO)	FREQUENZUNTERSCHIED-MESSGERÄT
ONDE INCIDENTE	ONDA INCIDENTE	ABGEHENDE WELLE
ONDE RÉFLÉCHIE	ONDA REFLEJADA	RÜCKKEHRENDE WELLE



For continuous determination of altitude above ground (terrain clearance), frequency-modulated continuous UHF waves are radiated from one of the aircraft's dipole aerials (whereby their frequency is varied linearly between a maximum and a minimum), reflected from the ground and received by the second dipole aerial. The difference in frequency between the transmitted and reflected waves, which is proportional to the terrain clearance, is measured by an interference measuring device and indicated in feet on the radio altimeter scale.

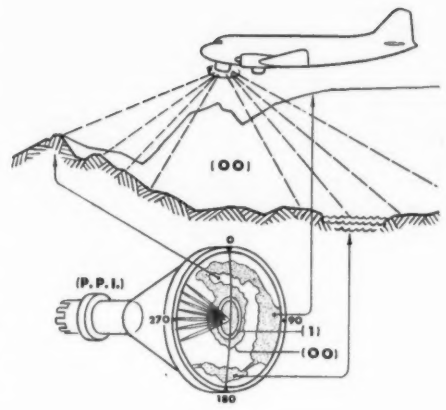
15 POSITION-FINDING AND COLLISION-WARNING BY SHF AIRBORNE RADAR

RADAR D'AÉRONEF ET DÉTECTEUR D'OBSTACLE (SHF)

RADAR DE AERONAVE Y DETECTOR DE OBSTÁCULO (SHF)

ORTUNG UND HINDERNISWARNUNG DURCH SHF RADAR-PANORAMAGERÄT

REVOLVING RADAR AERIAL	ANTENNE RADAR TOURNANTE	ANTENA RADAR GIRATORIA	UMLAUFENDE RADARANTENNE
CRO WITH REVOLVING TIME-INDICATING LINE (PPI)	OSCILLOSCOPE CATHODIQUE A BALAYAGE TOURNANT (PPI)	OSCILOSCOPIO CATÓDICO CON BARRIDO GIRATORIO (PPI)	KATHODENSTRAHLENRÖHRE MIT UMLAUFENDER ZEITLINIE (PPI)
TRANSMITTED-PULSE CIRCLE (BRIGHT ; 1)	CERCLE DES IMPULSIONS TRANSMISES (CLAIR ; 1)	CÍRCULO DE LAS IMPULSIONES TRASMITIDAS (CLARO : 1)	EIGENZACKENRING (HELL 1)
SAFETY CIRCLE OF CONE OF SILENCE (DARK ; 00)	CERCLE DE SÉCURITÉ DU CÔNE DE SILENCE (SOMBRE ; 00)	CÍRCULO DE SEGURIDAD DEL CONO DE SILENCIO (OBSCURO : OO)	SICHERHEITSKREIS DES SCHWEIGEKEGELS (DUNKEL ; 00)



The terrain outside a cone of silence directly below the aircraft is scanned by a rapidly-revolving, very narrow, SHF (microwave) beam, and the reflections from the ground, or echoes, are reproduced on the scope of a cathode ray tube with a revolving time-indicating line synchronised with the aerial. Bright areas on the scope signify strong echoes ; dark areas are " no-signal areas," indicating a body of water or shadows behind major terrain elevations. In this way a rough " shadow picture " is presented of the terrain below, hence facilitating position-finding. Elevations near flight altitude cause strong shadows to appear at the edge of the Plan Position Indicator, thus warning of obstacles. The system can also be adapted to detect storm clouds and other aircraft.

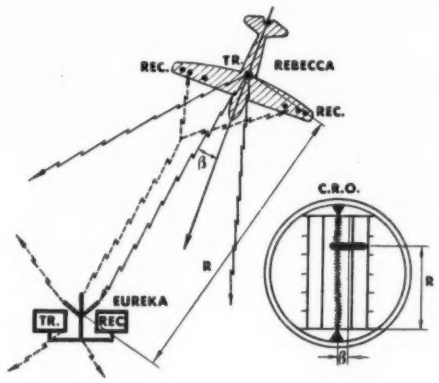
16 DISTANCE-MEASURING AND HOMING BY VHF " REBECCA-EUREKA "

" REBECCA-EUREKA " ÉQUIPEMENT VHF POUR LA MESURE DES DISTANCES ET LE HOMING

„ REBECCA-EUREKA " EQUIPO VHF PARA LA MEDIDA DE LAS DISTANCIAS Y DEL HOMING

VHF DISTANZ-MESS- UND ZIELFLUG-VERFAHREN " REBECCA-EUREKA "

" EUREKA " (GROUND RESPONDER)	" EUREKA " (RÉPONDEUR AU SOL)	" EUREKA " (RESPONDEDOR EN EL SUELO)	" EUREKA " (WIEDERHOLER AM BODEN)
" REBECCA " (AIRBORNE INTERROGATOR)	" REBECCA " (INTERROGATEUR D'AÉRONEF)	" REBECCA " (INTERROGADOR DE AERONAVE)	" REBECCA " (BORDAUSRÜSTUNG)
CENTRAL TRANSMITTING AERIAL ; DOUBLE RECEIVING AERIALS (AIRBORNE)	ANTENNE CENTRALE D'ÉMISSION ; ANTENNES DOUBLES DE RÉCEPTION (D'AÉRONEF)	ANTENA CENTRAL DE EMISIÓN ; ANTENAS DOBLES DE RECEPCIÓN (DE AERONAVE)	ZENTRALE SENDE-ANTENNE ; DOPPELTE EMPFANGSANTENNEN (AN BORD)
" A " SCOPE PRESENTATION OF CRO	" A "-SCOPE CRO	" A "- SCOPE CRO	SICHTGERÄT MIT ZWEISEITIGEM ECHOZACKEN



Short-range aid to navigation off airways, used primarily for homing. An airborne radar station (" Rebecca ") emits through its central transmitting aerial system VHF pulses which are repeated on a different frequency by a non-directional ground responder (" Eureka ") located in aerodrome vicinity, received on board the aircraft by two azimuth D/F aerials, and displayed on the " A " scope of a CRO with indications of distance (R) and approximate relative bearing (β). Range is 50-100 miles, according to altitude and output of " Eureka " beacon.

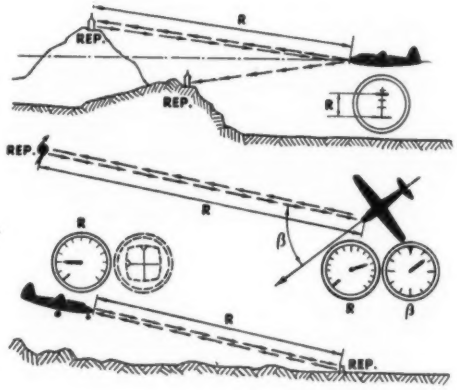
17 UHF (RADAR) LAMINAR-NAVIGATION AND ANTI-COLLISION SYSTEM (" LANAC ")

SYSTÈME DE NAVIGATION " LANAC " (UHF)

SISTEMA DE NAVEGACIÓN " LANAC " (UHF)

UHF RADAR-FLUG-SICHERUNGSSYSTEM " LANAC "

" CHALLENGER " (TRANSCEIVER)	INTERROGATEUR (ÉMETTEUR-RÉCEPTEUR)	INTERROGADOR (EMISOR-RECEPTOR)	AUFFORDERUNGS-SENDER-EMPFÄNGER
WITH CODER (FOR ALTITUDE, ETC.)	AVEC CODEUR (POUR L'ALTITUDE, ETC.)	CON CIFRADOR (PARA LA ALTITUD, ETC.)	MIT IMPULSWÄHLER (FÜR HÖHE, ETC.)
REPLIER OR TRANSPONDER (RECEIVER-TRANSMITTER)	RÉPONDEUR OU TRANSPONDEUR (RÉCEPTEUR-ÉMETTEUR)	RESPONDEDOR O TRANSPONDEDOR (RECEPTOR-EMISOR)	ANTWORT-EMPFÄNGER-SENDER
WITH DECODER AND IDENTITY CODER	AVEC DÉCODEUR ET CODEUR D'IDENTITÉ	CON DESCIFRADOR Y CIFRADOR DE IDENTIDAD	MIT ENTSCHLÜSSELUNGS- UND ERKENNUNGSGERÄT



A projected automatic system embracing short-range aids to navigation, collision- and obstacle-warning, instrument approach, and air traffic control. Each aircraft carries an automatic UHF transceiver (" Challenger ") which, according to the setting of a coder switch coupled with an aneroid barometer, emits keyed pulses with indications of flight altitude, etc. ; as well as a receiver-transmitter (Replier or Transponder) which automatically responds to signals received from the ground or other aircraft, using a decoder to evaluate these signals and an identity coder for simultaneously giving its own call sign and altitude. Furthermore, ground repliers are suitably distributed as aids to navigation and collision-warners, or located on runways as provision for instrument landings ; ground " Challengers " on aerodromes or airways are used for traffic control.

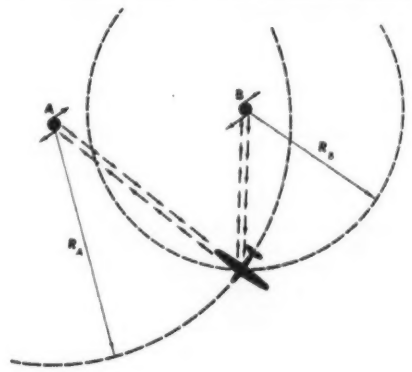
18 ABSOLUTE-DISTANCE MEASURING BY " OBOE "

SYSTÈME DE MESURE ABSOLUE DES DISTANCES " OBOE "

SISTEMA DE MEDIDA ABSOLUTA DE LAS DISTANCIAS " OBOE "

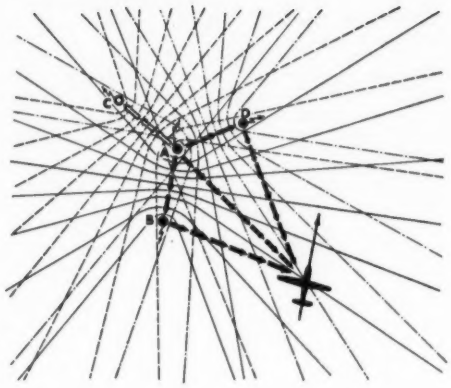
ABSOLUT-DISTANZ-MESSVERFAHREN " OBOE "

GROUND (OR AIRBORNE) TRANSCEIVER	ÉMETTEUR-RÉCEPTEUR AU SOL (OU D'ARÉONEF)	EMISOR-RECEPTOR EN TIERRA (O DE AERONAVE)	BODEN (ODER BORD) SENDER-EMPFÄNGER
AIRBORNE (OR GROUND) RESPONDER	RÉPONDEUR D'AÉRONEF (OU AU SOL)	RESPONDEDOR DE AERONAVE (O EN TIERRA)	BORD (ODER BODEN) IMPULSWIEDERHOLER



A navigational system first used during World War II, primarily in target-spotting missions, in which the absolute distance of the aircraft from two ground stations is determined, either by means of an airborne transceiver and two ground responders, or vice versa. The position of the aircraft is therefore at the intersection of two arcs. For target approach, one such arc passing through the target can be taken as flight path, intersection with the other arc giving the location of the target.

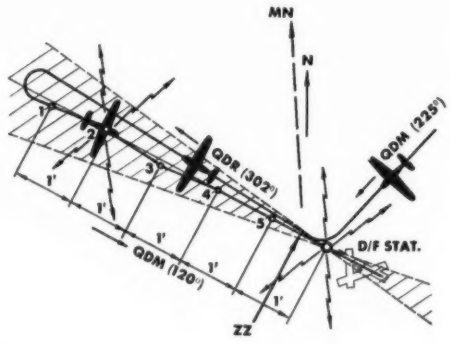
19	DIFFERENTIAL-DISTANCE MEASURING (HYPERBOLIC NAVIGATION)	MESURE DIFFÉRENTIELLE DES DISTANCES (SYSTÈMES HYPERBOLIQUES)	MEDIDA DIFERENCIAL DE DISTANCIAS (SISTEMAS HIPERBÓLICOS)	DIFFERENZ-DISTANZMESSSYSTEME (HYPERBEL-VERFAHREN)
	" GEE " UHF SHORT-DISTANCE NAVIGATIONAL AID	" GEE " (UHF) POUR LA NAVIGATION A COURTES DISTANCES	„ GEE " (UHF) PARA NAVEGACIÓN A CORTAS DISTANCIAS	" GEE " (UHF) FÜR KURZSTRECKEN-NAVIGATION
	" LORAN " MF (LONG-RANGE AID TO NAVIGATION)	" LORAN " (MF) POUR LA NAVIGATION A LONGUES DISTANCES	„ LORAN " (MF) PARA NAVEGACIÓN A LARGAS DISTANCIAS	" LORAN " (MF) FÜR LANGSTRECKEN-NAVIGATION
	MASTER STATION (A)	STATION MAITRESSE (A)	ESTACIÓN MAESTRA (A)	HAUPTSENDER (A)
	SLAVE STATIONS (B, C, D)	STATIONS ESCLAVES (B, C, D)	ESTACIONES ESCLAVAS (B, C, D)	NEBENSENDER (B, C, D)



In " GEE " and " LORAN," the difference in travel-time of pulses emitted from three widely-separated ground stations (master station + 2 slave stations) are measured in an airborne receiver, each difference defining a hyperbola (locus of all points having a constant difference of distance from two fixed points). The position of the aircraft is at the intersection of two hyperbolae. Cathode-ray tubes are used for measuring the travel-time differences, the result being a four-digit hyperbola number. Positions are thus found by means of lattice charts superimposed on maps. LF " DECCA " and LF/MF " POPI " (Post Office Position Indicator), which are under test, are likewise hyperbolic navigational systems, but use phase comparison instead of radar.

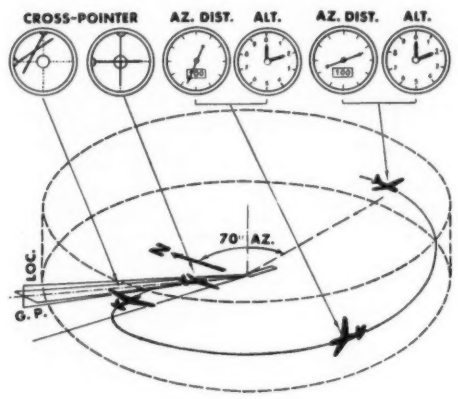
ALL-WEATHER LANDING

20	DESCENT THROUGH CLOUD (AND ZZ)	APPROCHE SANS VISIBILITÉ (ET ZZ)	ACCESO SIN VISIBILIDAD (Y ZZ)	EINFACHE DURCHSTOSSVERFAHREN (UND ZZ)
	DESCENT THROUGH CLOUD ABOVE AERODROME	PERCÉE A TRAVERS LES NUAGES AU-DESSUS DE L'AÉRODROME	TRAVESÍA A TRAVÉS DE NUBES POR ENCIMA DEL AERÓDROMO	DURCHSTOSSEN ÜBER DEM FLUGPLATZ
	DESCENT THROUGH CLOUD ABOVE RADIO BEACON	PERCÉE A TRAVERS LES NUAGES AU-DESSUS D'UN RADIOPHARE	TRAVESÍA A TRAVÉS DE NUBES POR ENCIMA DE UN RADIOFARO	DURCHSTOSSEN ÜBER EINEM FUNKFEUER
	ZZ LANDING PROCEDURE	ATTERRISSAGE ZZ	ATERRIZAJE ZZ	ZZ-VERFAHREN



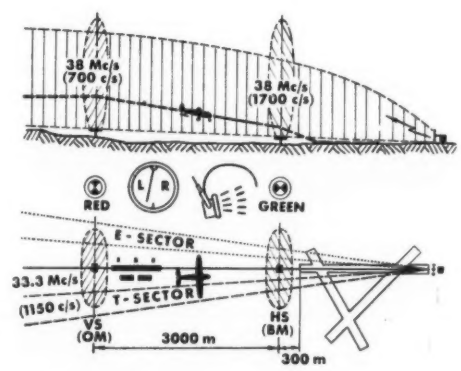
Ceiling permitting, SIMPLE DESCENT THROUGH CLOUD above an aerodrome or nearby radio beacon can be effected, ollowed by contact approach. If clouds conceal hazardous elevations, the ZZ PROCEDURE can be used for guidance through an obstacle-free sector to the aerodrome. Above the aerodrome, the pilot receives the barometric pressure at aerodrome level (QFE), flies away from the aerodrome along a prescribed QDR course for a few minutes, turns through 180 deg. and takes the QDM course for approaching the aerodrome at a prescribed altitude ; during this time he continuously emits signals, which are used by the ground D/F station to correct his course. Shortly before reaching the aerodrome boundary, the pilot receives the ZZ signal, subsequently descends until he can see the ground, and lands. In the event of a faulty approach, he receives the JJ signal, meaning he must interrupt his approach and repeat the manœuvre.

21	ORBITTING DESCENT AND APPROACH SYSTEMS	DESCENTE ET APPROCHE EN SPIRALE	DESCENSO Y ACCESO EN ESPIRAL	KREISFÖRMIGE DURCHSTOSS- UND ANFLUGVERFAHREN
	ORBITTING DESCENT ABOVE RADIO BEACON	DESCENTE EN SPIRALE AU-DESSUS D'UN RADIOPHARE	DESCENSO EN ESPIRAL POR ENCIMA DE UN RADIOFARO	SPIRALABSTIEG ÜBER EINEM FUNKFEUER
	ORBITTING APPROACH AROUND RADAR BEACON	DESCENTE EN SPIRALE AU-DESSUS D'UN RÉPONDEUR	DESCENSO EN ESPIRAL POR ENCIMA DE UN RESPONDEDOR	KREISANFLUG UM IMPULSWIEDERHOLER
	ORBIT METER (ATTACHED TO DME OR " REBECCA ")	ORBITE-MÈTRE (RATTACHÉ A UN DME OU UN REBECCA)	ÓRBITA-METRO (ENLACE A UN DME O A UN REBECCA)	KREISFLUGANZEIGER (ZUM DISTANZMESSGERÄT)
	ORBITTING RANGE SELECTOR (FOR AUTOMATIC PILOT)	SÉLECTEUR DE RAYON DE GIRATION (POUR LE PILOTE AUTOMATIQUE)	SELECTOR DE RADIO DE GIRO (PARA EL PILOTO AUTOMATICO)	KREISFLUGWÄHLSCHALTER (FÜR SELBSTSTEUERUNG)



An ORBITTING DESCENT through clouds, above a radio beacon, can also be made, using airborne D/F equipment. If the aircraft is equipped for distance measurement (and with an orbit meter) and the aerodrome with a non-directional radar beacon (e.g. " Eureka "), aircraft approaches can be carried out by an ORBITTING-APPROACH system (" Spider's Web " System, RAF Poor Visibility Landing System, etc.). Orbit radii and altitudes are communicated by the control tower to incoming aircraft in such a way that landings may be made in quick succession. The orbit meter enables the pilot to maintain his orbitting radius accurately ; there exist orbitting-range selectors for automatic-pilot devices.

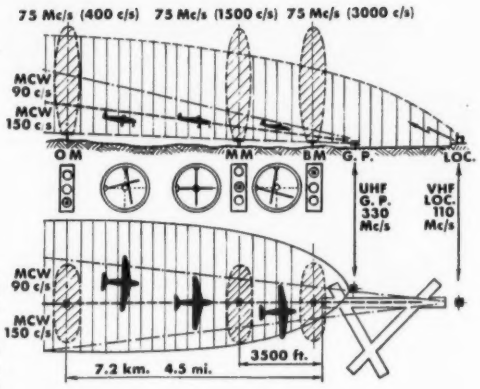
22	INSTRUMENT APPROACH ON ONE BEAM	ATTERRISSAGE AUX INSTRUMENTS SUR UN SEUL FAISCEAU	ATERRIZAJE CON INSTRUMENTOS SOBRE UN SOLO HAZ	BLINDLANDE-VERFAHREN AUF EINER LEITEBENE
	LORENZ (TELEFUNKEN) SYSTEM (VHF)	SYSTÈME LORENZ (TELEFUNKEN ; VHF)	SISTEMA LORENZ (TELEFUNKEN ; VHF)	LORENZ (TELEFUNKEN) SYSTEM (VHF)
	VHF STANDARD BEAM APPROACH (SBA)	SBA (VHF)	SBA (VHF)	SBA-SYSTEM (VHF)
	MF/LF RADIO RANGE (cf. 3)	RADIOPHARE D'ALIGNEMENT MF/LF (cf. 3)	RADIOFARO DE ALINEACIÓN MF/LF (cf. 3)	MF/LF RADIO RANGE (s. 3)
	VHF VISUAL-AURAL RANGE (cf. 4)	RADIOPHARE D'ALIGNEMENT VHF OPTIQUE ET ACOUSTIQUE (cf. 4)	RADIOFARO DE ALINEACIÓN VHF ÓPTICO Y ACÚSTICO (cf. 4)	VHF OPTISCH-AKUSTISCHE RADIO RANGE BAKE (s. 4)



A VHF localiser (or else an LF, MF or VHF radio-range beacon) at the end of a runway emits, in the direction least disturbed by obstacles and side-winds, two beam arrays keyed with E and T (or A and R) morse signals, giving an equi-signal zone in their plane of intersection. In this zone the signal is received in the aircraft as a continuous note ; deviations from this " on-course " zone are shown visually by a left-right indicator and/or aurally by predominant E or T (A or N) signals. Two vertically-radiating VHF marker beacons (in the Lorenz and SBA systems) serve to reveal the aircraft's distance from the runway threshold, since the pilot receives visual and aural signals when he is over them. Also, a rough idea of distance can be obtained from the increase in field strength of localiser reception, this being indicated by a pointer instrument. These data enable the pilot to keep to the prescribed approach path.

23 VHF/UHF INSTRUMENT LANDING SYSTEM (ILS) ON TWO BEAMS

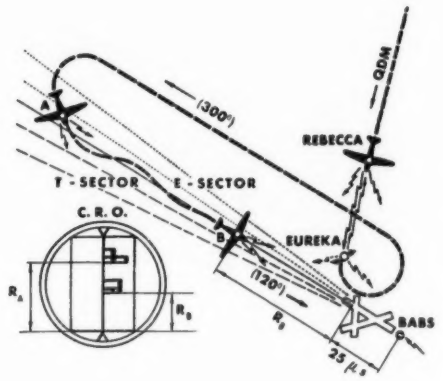
ILS (SYSTÈME D'ATTERRISSAGE SUR DEUX FAISCEAUX VHF/UHF)	ILS. (SISTEMA DE ATERRIZAJE SOBRE DOS HACES VHF/UHF)	VHF/UHF BLIND-LANDEVERFAHREN "ILS" AUF ZWEI LEITEBENEN
RADIOPHARE DIRECTIONNEL VHF	RADIOFARO DIRECCIONAL VHF (LOCALIZADOR)	VHF ANFLUGBAKE
RADIOPHARE DE TRAJECTOIRE DE DESCENTE UHF	RADIOFARO DE TRAYECTORIA DE DESCENSO UHF	UHF GLEITBAHNBAKE
TROIS RADIOBALISES VHF (cf. 2)	TRES RADIOBALIZAS VHF (cf. 2)	DREI VHF SIGNALBAKEN (s. 2)
INSTRUMENT A AIGUILLES EN CROIX ET SIGNAUX LUMINEUX	INSTRUMENTO CON AGUJAS EN CRUZ Y SEÑALES LUMINOSAS	KREUZZEIGER-INSTRUMENT UND MERKLEUCHTEN



The American ILS (also SCS.51 or CAA System), recommended by ICAO for international adoption, uses two guiding planes to define an approach path, which originate from a VHF localiser situated at the upwind end of the runway centre-line, and a UHF glide-path transmitter positioned away from the runway and on a level with the proposed touch-down point. Two pairs of MCW beam arrays, with 90 c/s modulation on one side and 150 c/s on the other, each intersect to define a plane. A cross-pointer instrument indicates the position of the two planes relative to the aircraft ; three VHF marker beacons (outer, middle and boundary markers) register visual or aural signals when the aircraft flies over them, thus indicating the distance away from the runway.

24 VHF (RADAR) BEAM APPROACH BEACON SYSTEM ("BABS") AND "REBECCA"

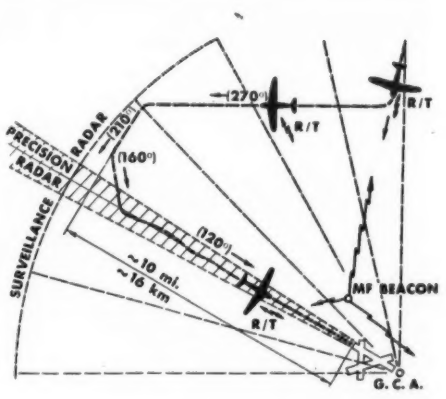
BABS-REBECCA (ATTERRISSAGE AUX INSTRUMENTS PAR RADAR VHF)	BABS-REBECCA (ATERRIZAJE CON INSTRUMENTOS POR RADAR VHF)	VHF RADAR-BLINDLANDEVERFAHREN "BABS - REBECCA"
RÉPONDEUR DIRECTIONNEL "BABS"	RESPONDEDOR DIRECCIONAL "BABS"	IMPULSWIEDERHOLERRICHTBAKE "BABS"
IMPULSIONS BRÈVES (POINTS ; E) A BABORD	IMPULSIONES BREVES (PUNTOS ; E) A BABOR	KURZIMPULSE (PUNKTE ; E) AUF BACKBORDSEITE
IMPULSIONS LONGUES (TRAITS ; T) A TRIBORD	IMPULSIONES LARGAS (TRAZOS ; T) A ESTRIBOR	LANGIMPULSE (STRICHE ; T) AUF STEUERBORDSEITE
DISTANCE AU POINT DE CONTACT	DISTANCIA AL PUNTO DE ATERRIZAJE	ENTFERNUNG BIS ZUM AUFSETZPUNKT



Aircraft equipped with "Rebecca" (cf. 16) can, after homing on a "Eureka" beacon (eventually orbitting around it ; cf. 21), use a "BABS" ground beacon as beam-approach aid. The pulses of the "Rebecca" equipment are answered by "BABS" on the port side of the approach path by dots, and on the starboard side by dashes, which appear on the "Rebecca" CRO scope as thin or thick echo signals. At point A dots are predominant, at point B both echo signals have equal strength and the aircraft is on the beam. The CRO time-base is delayed by 25 microseconds to permit the distance to the touch-down point (and not to the "BABS" beacon) to be given.

25 UHF/SHF (RADAR) GROUND CONTROLLED APPROACH (GCA)

GCA (UHF/SHF) APPROCHE SANS VISIBILITÉ)	GCA (UHF/SHF) ACCESO SIN VISIBILIDAD)	UHF/SHF RADAR-BLINDLANDE-VERFAHREN "GCA"
RADAR DE SURVEILLANCE UHF (PORTÉE 50 KM)	RADAR DE VIGILANCIA UHF (ALCANCE 50 KM)	UHF RADARSUCHGERÄT (50 KM. UMKREIS)
RADAR DE PRÉCISION SHF POUR LE SONDAGE EN SITE	RADAR DE PRECISIÓN SHF PARA EL SONDAJE EN PUESTO	SHF PRÄZISIONS-RADARGERÄT FÜR HÖHENMESSSTRAHL
RADAR DE PRÉCISION SHF POUR SONDAGE EN AZIMUT	RADAR DE PRECISIÓN SHF PARA SONDEO EN AZIMUT	SHF PRÄZISIONS-RADARGERÄT FÜR SEITENMESSSTRAHL
(CONSIGNES EN PHONIE)	(CONSIGNAS POR FONIA)	"HERUNTERSPRECHEN" (DURCH SPRECHFUNK-ANWEISUNGEN)

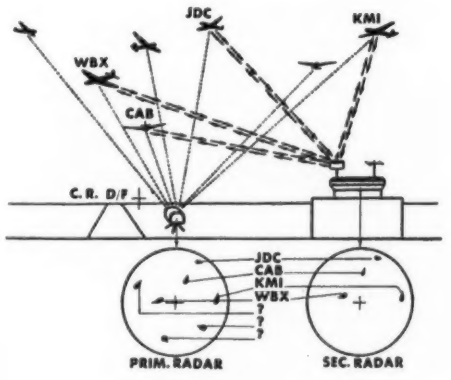


Aircraft within the 30-mile-range of GCA's rotating UHF surveillance radar aerial are registered on a PPI scope. Aircraft desiring to land receive R/T instructions guiding them into the zone of the two SHF precision radar beams which scan the approach sector in elevation and azimuth, and display the aircraft's progress on two scopes ; off-course deviations are communicated by R/T to the pilot. Airborne equipment, in addition to blind-flying instruments, can be confined to a VHF two-way radio to make the "talk-down" procedure possible.

RADAR AIR TRAFFIC CONTROL AND COMBINED SYSTEMS

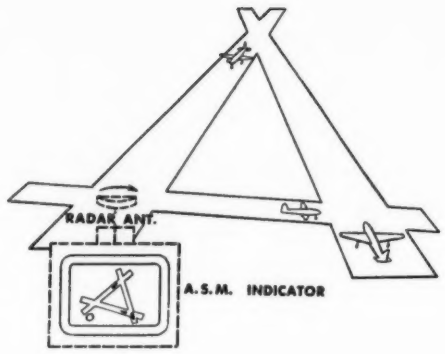
26 UHF/SHF AIRPORT CONTROL RADAR

CONTROLE DE L'ESPACE AÉRIEN PAR RADAR UHF/SHF	CONTROL DEL ESPACIO AÉRÓ POR RADAR UHF/SHF	UHF/SHF (RADAR-) LUFTRAUMÜBERWACHUNG
RADAR PRIMAIRE UHF	RADAR PRIMARIO UHF	UHF PRIMÄR-RADAR SUCHGERÄT
RADAR SECONDAIRE SHF/VHF	RADAR SECUNDARIO SHF/ VHF	SHF/VHF SEKUNDÄR-RADAR SUCHGERÄT
RÉPONDEUR D'AÉRONEF SHF/VHF	RESPONDEDOR DE AERONAVE SHF/VHF	SHF/VHF BORD-IMPULSWIEDERHOLER
PPI (A BALAYAGE TOURNANT)	PPI (CON BARRIDO GIRATORIO)	LUFTVERKEHRS-SICHTGERÄT (PPI) MIT DREHENDER ZEITLINIE



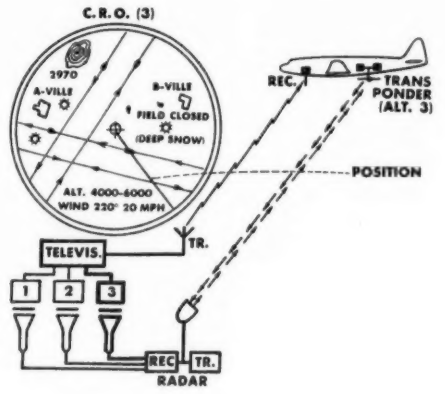
UHF primary airport-control radar, working on direct reflection of transmitted pulses, scans, by means of a rotating search aerial, the zone in aerodrome vicinity, detecting all nearby aircraft and presenting them on a PPI scope. It can be supplemented by a secondary radar set which detects only those aircraft having responders. For this purpose, the rotating aerial of the secondary radar set transmits SHF pulses which are answered on VHF by the airborne responders ; presented on a separate scope, these answers simultaneously give indications of aircraft identity and altitude (cf. 17). The secondary presentation is more free from clutter and enables "friends" and "strangers" to be distinguished. An automatic VHF ground D/F set (cf. 13) completes the system.

27	SHF (RADAR) AIRFIELD SURFACE MOVEMENT INDICATION	CONTROLE D'AÉROPORT PAR INDICATEUR DES MOUVEMENTS AU SOL SHF	CONTROL DE AEROPUERTO POR INDICADOR DE LOS MOVIMIENTOS EN TIERRA SHF	SHF (RADAR) ROLLFELDVERKEHRSKONTROLLE
	ASM INDICATOR	INDICATEUR DES MOUVEMENTS AU SOL	INDICADOR DE LOS MOVIMIENTOS EN TIERRA	ROLLBETRIEBSICHTGERÄT
	TAXIING INSTRUCTIONS (BY VHF R/T)	CONSIGNES POUR LE ROULEMENT (PAR PHONIE VHF)	CONSIGNAS PARA LA RODADURA (POR FONÍA VHF)	ROLLANWEISUNGEN (DURCH VHF SPRECHFUNK)



Projected system for supervising surface movement on large airports under bad-visibility conditions. All aircraft and vehicles on the aerodrome terrain are detected by SHF radar and presented on a PPI scope which is superimposed by a plan of the airport. Clearance instructions are given through VHF R/T.

28	UHF/SHF *TELE*VISION-RADAR AIR NAVIGATION (" TELERAN ")	SYSTÈME DE NAVIGATION " TELERAN " UHF/SHF PAR RADAR ET TÉLÉVISION)	SISTEMA DE NAVEGACIÓN " TELERAN " UHF/SHF (POR RADAR Y TELEVISIÓN)	UHF/SHF FERNSEH-RADAR-FLUGSICHERUNGSSYSTEM " TELERAN "
	UHF EN-ROUTE RADAR	RADAR DE ROUTE UHF	RADAR DE RUTA UHF	UHF STRECKEN-RADAR
	UHF AIRPORT RADAR	RADAR D'AÉROPORT UHF	RADAR DE AEROPUERTO UHF	UHF FLUGPLATZ-RADAR
	SHF PRECISION RADAR (FOR TELEVISION-GCA)	RADAR DE PRÉCISION SHF (POUR ATTERRISSAGE PAR GCA)	RADAR DE PRECISIÓN SHF (PARA ATERRIZAJE POR GCA)	SHF PRÄZISIONS-RADAR (FÜR BILDFUNK-GCA BLINDLANDUNG)
	AIRBORNE TELEVISION RECEIVER AND RADAR TRANSPONDER	RÉCEPTEUR DE TÉLÉVISION D'AÉRONEF ET TRANSPONDEUR RADAR	RECEPTOR DE TELEVISIÓN DE AERONAVE Y TRANSPONDEDOR RADAR	BORD-FERNSEHEMPFÄNGER UND RADARWIEDERHOLER (MIT HÖHENANGABE)



A projected combined system for air navigation, traffic control, collision warning, etc. The pilot continuously receives simplified pictorial displays for all traffic manœuvres (taxiing, instrument take-offs, flight at different levels, blind approaches and landings) on his own cockpit television scope, thus aiding him to navigate, warning him of obstacles, giving him weather and route reports, etc. Ground search radar scans the entire air-space, interrogating all passing aircraft and, according to answers received from airborne radar transponders, allocates several specific levels and registers the entire traffic situation on PPI scopes ; superimposed by transparent charts showing maps as well as weather and wind data, etc., the PPI displays are televised to the aircraft.

SOME CONVENTIONAL ABBREVIATIONS

ACR = Approach Control Radar (26)
ADC = Aerodrome Control (26, 27)
ADF = Automatic Direction Finder (10)
APC = Approach Control (26)
ASMI = Airfield Surface Movement Indicator (27)
ATC = Air Traffic Control
BABS = Blind Approach Beacon System (24)
BCN = Beacon
BM = Boundary Marker (2, 22, 23)
COM = Communication (1)
CR.D/F = Cathode Ray Direction Finder (13)
CRT (CRO) = Cathode Ray Tube (Oscillograph) (13-19)
CW = Continuous Wave
D/F = Direction Finder (9-13)
DME = Distance Measuring Equipment (5, 16, 17, 18, 21, 24)
DRB = Distance by Radar Beacon
FIDO = Fog, Intensive Dispersal Of
FIR = Flight Information Region
FM = Fan Marker (2, 3, 4)
GCA = Ground Controlled Approach (25)
GP = Glide Path Transmitter (23)
IFR = Instrument Flight Rules
ILS = Instrument Landing System (23)
IM = Inner Marker (2, 22, 23)
LAN = Landing Aid
LF = Low Frequency
LOC = Localiser (22, 23)
M = Marker (2)
MCW = Modulated Continuous Wave
MF = Medium Frequency
MLS = Microwave Landing System
MM = Middle Marker (2, 23)
MTI = Moving Target Indicator (26)
MTR = Multiple Track Radar Range (19)
NAV = Navigational Aid
NDB = Non-Directional Beacon
OM = Outer Marker (2, 22, 23)
PPI = Plan Position Indicator (15, 17, 25-28)
PRF = Pulse Recurrence Frequency
RF = Radio Frequency
RNG = Radio Range (3)
RT = Radio Telephony (1)
SBA = Standard Beam Approach (22)
SHF = Super High Frequency
UHF = Ultra High Frequency
VAR = Visual-Aural Range (4)
VFR = Visual Flight Rules
VHF = Very High Frequency
VLF = Very Low Frequency
VOR = Visual Omni-Range (5)
W/T = Wireless Telegraphy (1)
ZM = Z-Marker (2)

Russian Aircraft for Export

The YAK-18 two-seater trainer, equipped with a 160-H.P. radial and a hydraulically-retractable undercarriage.

It has always been understood that if a country decides to export a commodity, it is because it possesses some sort of natural monopoly on the commodity's origin, or is able to produce the said commodity at least cheaper, if not better, than the importing country can. And at all events, one expects to see at an industrial fair, products which have a fair chance of finding a place on foreign markets. But judging from certain postwar events of this nature, we are led to believe that the principles of export trade, bent under the weight of new and stronger influences, have become considerably warped.

Soon after war's end, the Soviet Union decided once more to make certain items of its aircraft production free for export. And thus during the second half of 1948 a number of Russian civil aircraft were put on show at trade exhibitions in Posen (Poland), Helsinki, Budapest and Prague. It is not the first time that Russia has offered aircraft for sale ; she put on quite a big show at the Paris Salon in 1936. It is therefore most interesting to make a comparison between the latest exhibitions and that held in France twelve years ago.

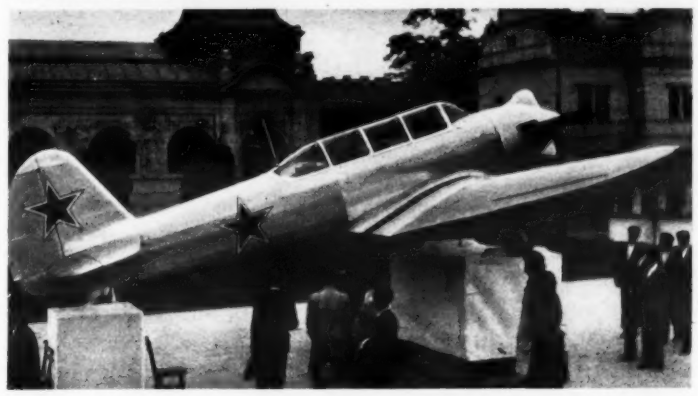
In 1936 Russia exhibited many aircraft which lacked none of the qualities of those of her European and American rivals. A famed single-engined long-range aircraft, the ANT-25, which two years beforehand had covered some 7,500 miles non-stop, made an excellent impression on visitors to Paris ; and the twin engined ANT 35 commercial transport was undoubtedly abreast of its day. Also the finishing touches of the Russian products, concerning which very contrasting views reigned in Western Europe, helped to provide a favourable opinion on the capabilities of the Soviet aircraft manufacturing industry.

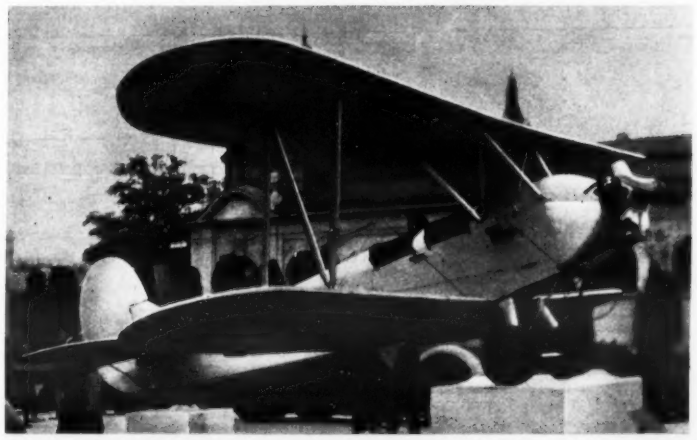
And in 1948 ? Four different Russian aircraft were on show at each of the exhibitions in Poland, Finland, Hungary and Czechoslovakia.

The *Polikarpov Po-2*, a two-seater training aircraft, is a perfect example of what was manufactured fifteen or twenty years ago in Europe, the U.S.A. and elsewhere—and perhaps also in the Soviet Union. It is hardly believable that its exhibitors are so optimistic as to expect large sales of the Po-2 west of the "curtain." We can only believe that customers over there are given different line of sales talk. However, we shall just mention that this aircraft is powered by a 115-H. P. radial engine and represents the standard light aircraft of Russian civil aviation ; as for the rest, the accompanying photographs speak for themselves.

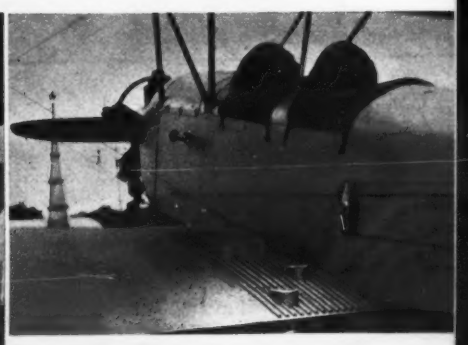
The *Yakovlev YAK-18*, which has been developed from the Russian Ut-2 trainer, has an air-cooled five-cylinder M 11 RF radial engine of 160 H. P. and a hydraulically-retractable undercarriage (the main wheels retract halfway ; the tail-wheel is fixed). Weighing 2,360 lbs. all-up, it is stated to have a cruising speed of 133 m. p. h., a range of 560 miles and a ceiling of 16,400 ft. The landing run amounts to 270 yds. and the landing speed 53 m. p. h. with the split flaps, positioned in the wing centre section, fully deflected.

Considerably more interest is earned by the *Yakovlev YAK-16*, a twin-engined feeder transport which was almost unknown outside Russia up to the time of the exhibition in Posen. An all-metal low-wing monoplane fitted with two ASch 21 seven-cylinder radials (with





The Po-2 elementary trainer.



The 10-passenger YAK-15 twin-engined feeder, which cruises at 180 m.p.h.

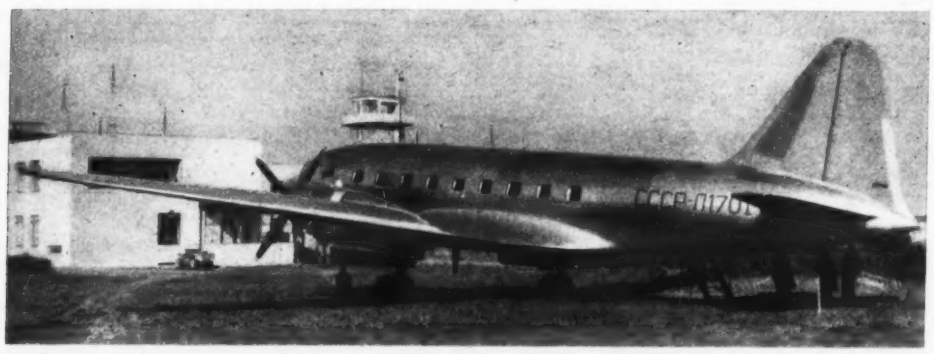
direct fuel injection), each of 690 H. P. take-off power and 620 H. P. rated power, it is designed to carry ten passengers over ranges of more than 600 miles ; the crew comprises three members. Both externally and from the standpoint of interior layout, the YAK-16, as far as one can judge from photos and manufacturers' data, makes a good impression. Whether it can really take off with full load in 285 yards, as it is claimed to do, remains to be seen. Apart from the span of 85 ft. 3 in. and gross weight of 14,100 lbs., no further data on dimensions or weight distribution are available as yet.

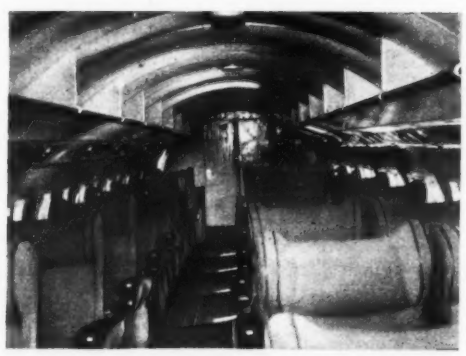
The *Ilyushin IL-12*, undoubtedly the most modern twin-engined commercial transport Russia possesses, was officially unveiled early this year and has already been described many times. Designed for medium routes, it accommodates 27 or 32 passengers (five-man crew) and is on a par with the modern European medium-range aircraft, although reports so far received indicate a performance slightly behind that of its rivals. The IL-12 is powered by two ASch 82 FN 14-cylinder radials, each furnishing 1,785 H.P. for take-off, and has four blade controllable-pitch propellers. Range with full load is stated to be about 1,250 miles. Like all modern aircraft of its category, the IL-12 has a tricycle undercarriage ; span amounts to 104 ft., length 69 ft. 10 ½ in., and height 26 ft. 6 in. Grossing 38,030 lbs., the payload is given as 6,610 lbs., whereas the cruising speed at normal altitude averages 208 m.p.h. A very simple solution has been found for anti-icing : fresh air taken in through scoops on the fuselage is driven by the ram pressure through the oil cooler and led to the wing leading edge ; in the tail assembly, de-icing air is heated by means of electric resistances. There are no special blowers for conveying the air.

There is no doubt that the IL-12 has been and is being built in considerable numbers, and it is furthermore reported that it has a military transport counterpart, for which it has been possible to step the payload up to 8,820 lbs. The Russian Aeroflot airline has been operating the civil version for some time already, and it is learned that the Czechoslovak CSA carrier is interested in purchasing a number of units.

Looking back on these 1948 aeronautical exhibitions, we are again faced with the old task of "de-enigmatising" Russian intentions. Why do the Soviets exhibit, alongside really interesting and praiseworthy constructions, items whose right place is in a museum ? There seems to be little doubt that they are capable of revealing quite other things to western eyes. Or is that (as in the Finnish campaign) they wish to inveigle the West into underestimating the Russian industrial potential ?

The Ilyushin IL-12, Russia's most modern medium-range airliner. Manned by a crew of five, it cruises at 208 m.p.h., carrying 27 to 32 passengers.





Mail it by Jet

A terrific feat was recently achieved by a team of British and French aviators. A letter was whizzed through the ether from London to Paris in 46 minutes and 29 seconds. There were, as a matter of fact, a few extra tenths of a second—too negligible to quibble over. Besides, as the letter was from the Lord Mayor of London to his Parisian opposite number, thus very much number-one citizens both, fractional figures are decidedly out of place.

For the benefit of those ignoramuses (or is it ignorami ?) who didn't read about it, here are the facts in brief. On a certain day which may or may not go down in history, an airman to whom the Lord Mayor had handed the missive (one could almost say 'missile') took off from behind St. Paul's Cathedral, landed a few minutes later at Biggin Hill aerodrome, transferred the precious envelope to another pilot who, flying a Gloster "Meteor" jet plane, touched down about 30 minutes later at Orly airport outside Paris. Another rotary-winged messenger then reversed the initial operation, completing his mission on the Invalides Esplanade in the heart of Paris, where a jubilant crowd watched the envelope reach its final destination.

Though I fully share the general enthusiasm aroused by this exploit, I must confess to the presence of a fly in the otherwise joyful ointment. Maybe curiosity did kill the cat and all that, but what I want to know is the contents of the message. Such secrecy must always give rise to wild conjecture, and if any misleading rumours arise in connection with the present event, the two metropolitan potentates have no one to blame but their right-honourable selves. I give you two versions which, I am forced to confess, emanate from the most unreliable sources imaginable :

> "With pleasure and pride I propel to you my promptest and profoundest praises, and hope to do better next time."

> "My dear friend : Remember that the secret of making good tea is first to scald the pot, then put in one teaspoonful of leaves per person and one spoonful for the pot. Your esteemed compatriots have a deplorable habit of forgetting these details. In exchange, I would be gratified to know whether what I hear from France is true — that there exists another vegetable dish besides boiled cabbage."

Whilst the supreme importance of these diplomatic exchanges, particularly the second one, is beyond dispute, it is nevertheless doubtful whether such a hustling mode of delivery was quite the thing, since it seems so utterly out of harmony with the dignity one usually associates with State procedures. Looking at it from a commercial angle : is this sort of thing likely to arouse public interest to the extent that postal authorities will ultimately institute scheduled jet mails ?—advertising by epigrams like :

> Speedier mails, did you say ?
> Well try out our new special way.
> We send it by jet,
> And lay you a bet,
> It arrives on the preceding day !

As it happens, I have studied the problem, and have come to the conclusion that the sort of people who would go in for a jet mail service fall into two categories : Lovers and Gangsters. Lovers, in my opinion, are the only really human people in this world, for they never think of making wars, earning money, taking other people's money, finding that there is too much salt in their food or that the weather forecast is always wrong ; to them, the sky is invariably blue. And gangsters, whatever their racket, are the only people who get anything done nowadays—doing it with thoroughness and professional skill which many so-called craftsmen would do well to emulate.

To take a practical example : it is quite certain that on the day under discussion, there were many young men in London who would have wished for nothing better than to send, by jet mail, tender greetings to a girl friend in Paris. You may object on the grounds that they could easily telephone. However, your objection would be ridiculous. People really in love don't use the telephone, but write love-letters, the only genuine form of expressing sentiment of this sort over a distance. Have you ever witnessed the sickening spectacle of a would-be Romeo struggling to convey sweet kisses through the bakelite mouthpiece of a public call box ? If so, it must have struck you that Mr. Alexander Graham Bell never intended his invention to be used for such purposes. Or if — you'll pardon my indiscretion — you were ever caught in these circumstances, did you not immediately cease your osculant antics, endeavouring to look as full of worldly wisdom as a tree full of owls ? As you see, the telephone must be struck off the list as far as true lovers are concerned. They will always write love-letters, the most convenient, time-saving and — it is said — hygienic way of conveying a thousand kisses.

And now, suppose for a minute that no Londonian lover was desirous of jet-propelling his tender regards on that particular day. Surely the gangsters had a legally-incorporated Paris subsidiary or associate firm to which they would have liked to shoot over a hot tip. For example : "We know that you are up to your ears in work, but we thought you might like to know that the Maharaja of Opossum, possessor of the famous diamond, is leaving for the country this afternoon to visit the Comtesse de Marmalade. We have it on good authority that he will not give her the diamond on this visit. She is not lucky, but you may be. Fifty-fifty as usual. Cordially yours."

Understandably, highly confidential information of this sort cannot be transmitted by telephone or telegram. An ordinary letter would take too long. But the jet mail idea really fills the bill.

And since we are toying with hypotheses, we might—by an extremely fanciful turn of mind—imagine that the managing editor of Interavia was in London that day and suddenly wished to send me a message stating : "My dear Yves : I must say that I find your stuff jolly good, and am taking the liberty of henceforth increasing your fee tenfold."

True, I don't mind admitting that, in such circumstances, a telephone message would do just as well—to Trudaine 83-02.

However, you may have concluded that I belong in a third category, the most harmless of all—that of the crackpots. *Yves Grosrichard.*

The S.51, with full load, rises from a Swiss Alpine airfield.

Helicopters in the Alps

We all know that the helicopter, our youngest means of transportation, is very suitable for delivering the mail in big cities and for crop dusting out in the country. We have heard much of its operation in connection with rescue services at sea, supplying isolated lighthouses, inspecting high tension cables and pipe lines, and so forth. Nowadays there are about a dozen types which can do all these things with the greatest of ease. From having witnessed it in reality, from photos and newreels, the public has finally been convinced that helicopters are really able to rise and descend vertically, fly sideways, backwards and, of course, forwards—even accomplishing the latter manœuvre with rather great speeds—and accommodate two or more people.

Meanwhile, however, helicopters have hitherto been seen over flat country only. Their climbing performance and behaviour at altitude are, so to speak, known only "theoretically" from manufacturers' data, which indicate—and then only for a certain gross weight—a ceiling altitude for an oblique ascent and a so-called hovering ceiling. The accompanying table gives a few data for four well-known helicopters (sufficient information is unfortunately not yet available on the Bristol 171). It will be noticed that the hovering limit, even with ground effect, is only about half the service ceiling, and far less without ground effect. It is evident, therefore, that the helicopter, too, requires forward speed in order to attain greater altitudes. It would seem that its hovering limit near the ground is determinant for its alpine airworthiness, this providing the weather is good enough ; in inclement weather, on the other hand, the deciding factor is the hovering ceiling attainable without ground effect.

Type	Service ceiling	Hovering ceiling ground effect	Hovering ceiling no ground effect	Rate of climb at sea-level	Gross weight	Maximum engine power
	ft.	ft.	ft.	ft./sec.	lbs.	H.P.
Bell 47 B (two-seater)	11,500	5,400	—	15	2,090	(Franklin 6V4) 128 H.P.
Hiller 360 (two-seater)	12,000	—	—	16	2,100	(3,000 r.p.m. sea-level)
Fairey "Gyrodyne" (four-seater)	*c.* 16,500	—	—	17	4,800	(Alvis 501) 520-540 H.P.
Westland-Sikorsky S.51 (four-seater)	14,000	7,000	5,100	20	5,000	(3,000 r.p.m. 0—4,250 ft.)

The helicopter should therefore be able to land vertically in mountainous regions and take off again without forward movement along the ground ; thus it ought to be able to hover near to the ground, for which purpose a considerably higher engine power is necessary than for forward flight. Once it has left the take-off spot and is hovering, at least a few feet, above the ground, further altitude may be gained in forward ascent with better rotor output ; and, after landing on a lower terrain, for instance, it should be able to take off again.

Meanwhile, this is all very well as long as the visibility is good. But the weather in the Alps is sometimes so bad that, according to mondain mountain guides, even the eagles prefer to walk. Under these circumstances, even the slightest forward speed can be hazardous, so that for operations in bad weather, the helicopter's hovering ceiling with ground effect is the determinant factor.

Bound for the Grimsel, an Alpine pass topping 7,000 ft.

Let us dwell a little on the physical fundamentals of the two hovering ceilings : the rotor lift, when hovering without ground effect, decreases with altitude as the cubic root of the air density and the cubic root of the square of the engine output, and moreover, augments considerably near to the ground, owing to the cushioning effect of the air. At 6,600 ft., where the air density amounts to only 82 per cent. of that at sea level, the rotor lift decreases to 93.5 per cent. for this reason alone. It therefore becomes all the more important that at least the engine output should remain constant. However, this only happens in supercharged engines ; ordinary engines lose about 20 per cent. of their rated power at this altitude, thereby reducing the rotor lift from 93.5 to about 80 per cent. Since the tare weight of present-day helicopters is very high, amounting to at least 70-75 per cent. of the all-up weight, the take-off and landing altitude of helicopters without supercharged engines (Bell 47B and Hiller 360) is limited,

even if no passenger and little fuel is taken on board. It remains, therefore, that only supercharged engines can enable adequate hovering performance to be attained for alpine flying. The four-seater Bristol 171 and Westland-Sikorsky S.51 helicopters are therefore fitted with the Pratt & Whitney "Wasp Junior" air-cooled nine-cylinder supercharged radial, furnishing 450 H.P. at 2,300 r.p.m. up to about 3,500 ft. altitude (and more power at higher r.p.m.), and are later to be equipped with the Alvis "Leonides" engine, at present installed and being tested in the Fairy "Gyrodyne" ; at 3,000 r.p.m. this engine delivers 520-540 H.P. up to an altitude of 4,250 ft., and 440 H.P. at 10,000 ft.

It is evident that we can clarify the question of helicopter alpine airworthiness more thoroughly with the aid of practical flight tests than with theoretical considerations. It is for this reason that the demonstration of a Westland-Sikorsky S.51 in the Swiss Alps from September 22nd to 28th, 1948, at the instigation of Air-Import A.G., Lucerne, shown in the accompanying photographs, may be of interest.

The S.51, developed by the Sikorsky Division of United Aircraft Corp. and also manufactured under licence in Great Britain by Westland Aircraft, Ltd., of Yeovil, Somerset, was demonstrated by a Westland test pilot, Mr. Allan Bristow. The weather was extremely favourable and a number of vertical landings and take-offs were made at altitudes between 5,850 and 7,500 feet. Powered by a "Wasp Junior" engine, this helicopter has an empty weight of about 3,750 lbs. and a permissible all-up weight of 5,000 lbs., thus a disposable load of some 4,250 lbs. and, according to range, a payload of 390 to 790 lbs. ; rotor diameter is 48 feet. and disc area 1,810 sq. ft.

The S.51 was first demonstrated in the Bernese Oberland, in the vicinity of the Grimsel Pass, accomplishing a vertical landing on the shore of the Totensee Lake, which is at 7,100 ft. above sea level, followed by a vertical take-off. The terrain was such that the shortest of take-off runs would have been impossible. Two persons were on board, and the gross weight at the landing point was 4,950 lbs. In the adjacent Axalp region, with the gross weight approximately the same as beforehand, though there were three occupants, the S.51 subsequently made four vertical landings and take-offs—two at 5,850 ft. and two at 6,900 ft. above sea level. Finally, it landed and took off from the 7,500-ft. Ebenfluh mountain, without the least take-off run. Nevertheless, the gross weight on this occasion was only 4,780 lbs. and no passenger was carried.

These flights were sufficient to show that the S.51 is capable of accomplishing all it claimed to do in the way of climbing. It was the first time a helicopter had been put through its paces in the Alps. As a matter

Just before landing on the shores of the Totensee Lake, 7,100 ft. above sea level, with gross weight almost at a maximum.

of course, the pilot proceeded with the utmost caution, since it was also his first Alpine flight. And moreover, the weather was perfect.

It will now be necessary to execute further systematic test flights under adverse wind and weather conditions, before the operational requisites can be defined in full. Numerous questions still remain to be answered. How must a helicopter cope with the strong, terrain-dictated down currents, and thermals, with occur in the Alps as often as unexpectedly ? And how, if at all, should this be done if a machine has to fly without much engine power reserve ? What would be the effect of warm mountain winds ? Which minimum forward speed must be maintained when visibility is bad or clouds conceal mountain peaks ? How does the attainable ceiling alter with decreasing flying speed ?

The experience gained and dearly paid for in alpine flying with low-powered sports aeroplanes, reveals that a great deal of piloting skill and knowledge is necessary for coping with the manifold dangers of the Alps. This will also apply to helicopters, which will likewise have to use their engine power to the very limit.

Admittedly, it is has already been shown that powerful helicopters, providing the weather is good, can be operated in Alpine regions, effect landings at altitudes up to 6,500 ft. above sea level, and accomplish numerous missions, such as transporting sick people, carrying doctors into otherwise inaccessible regions, help in constructing cable railways and big dams, supplying meteorological outposts, and transporting soldiers and military equipment. In the event of really bad weather, or for landings and take-offs at altitudes of over 6,500 ft.—conditions which can very well arise in rescue operations—it will nevertheless be necessary to have better hovering ceilings and possibly greater reserves of power. This is precisely where improved helicopter power plants, and perhaps the utilisation of turbine engines, step into the picture.

Nature-loving mountaineers need have no fear about our being on the threshold of a "helicopter-mountaineering era." It is very likely that the 14,770-ft. Matterhorn will remain their happy hunting ground for quite some time to come. And helicopters, having to content themselves with take-off terrains at only half this altitude, will just have to go on "comin' round the mountain." However, the time will eventually come ; but alpine climbers, who have already made friends with the cable railway, will surely take kindly to the helicopter.

Even if the weather is good, pilots need to be cautious and experienced because of strong down currents in the Alps

Ideas for Advancing Sailplane Design

BY W. HUETTER, SALZBURG

WOLFGANG HUETTER, B. Sc., author of this article, has devoted some twenty years to the development and construction of sailplanes and has built a number of types which have made his name known in many countries. His intention here is to show a way by which soaring flight, as a sport, can be fostered and made available to more people, by building sailplanes on a production-line basis.

After the war-dictated standstill in sailplane design and construction, it is natural that we should wish to know the direction in which the development of these aircraft should now continue. In point of fact, a few new types have been built since the war—for instance the WLM-1* in Switzerland and the Lunak L 107 in Czechoslovakia. And an examination of them shows that their designs were based on three principal requirements : greater speed for distance flight, increased structural strength for cloud flying, and also suitability as trainers for instructing future aeroplane pilots. In line with the inevitable tendency of every technical task to involve a compromise of some sort, in this particular case the requirements could not be fulfilled without penalising the minimum sinking speed and boosting the purchase price to a relatively high level.

Before examining the technical aspects in detail, it will be profitable first to consider the situation of sailplane construction in relation to the entire aircraft manufacturing industry.

In prewar times, gliding and soaring contributed in many ways to the general progress of aviation. We only need to think of the aerodynamic research effected with the aid of motorless aircraft, or the development of cargo gliders and unpowered scale models in conjunction with the building of large aeroplanes.

Nowadays, cargo gliders no longer have anything in common with sailplanes. Apart from this, they have frequently evolved into low-powered transport aeroplanes. The motorless experimental glider is now an integral part of the big industry, and sporting sailplanes have been pushed into the background by the development of turbine-powered supersonic aircraft or gigantic stratosphere types. Precisely these considerations, meanwhile, bring the sporting aspects of soaring flight to the foreground. Unfortunately, however, we see that this type of sport simply cannot count on adequate government subsidisation, despite the fact that most nations take a sympathetic attitude towards its introduction and development.

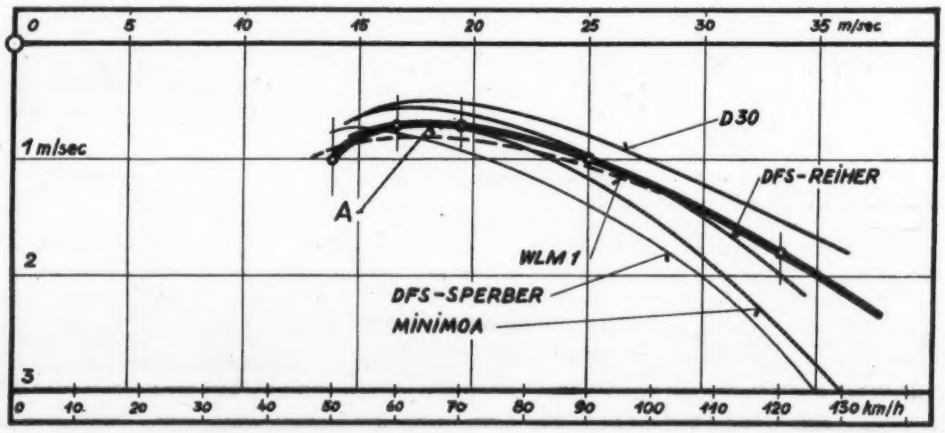
Therefore, in order to place soaring flight within the reach of at least a few more people, and to gain new enthusiasts, it is most essential to lower very considerably the purchase price of sailplanes.

However, this should under no circumstance lead to a drop in performance. On the contrary, a simultaneous effort should be made to increase flight performance and safety.

The present-day aim in increasing the performance is mainly to attain at once better L/D ratios and higher speeds. In doing this, however, the best sinking speed should nevertheless remain within the limits provided by good prewar sailplanes, for it is obvious that high speed is useless if the aircraft loses altitude every time it flies into a dead-calm region. In such instances, differences of a few centimetres a second in the sinking speed can be decisive. What, then, must be the characteristics of a modern sailplane which costs a reasonable sum to buy and all the same offers a high degree of performance and safety ?

Flight Performance. Fig. 1 shows the polar curves (sinking speed versus flying speed) of a few well-known sailplanes, alongside the polar curve suggested by the author as a basis for future design and development. The lower part of this curve is applicable to the conventional, good sailplanes of today, featuring a minimum speed of 50 km./hr. accompanied by a sinking speed of about 1 m./sec., the lowest

Fig. 1: POLAR CURVES of a number of well-known sailplanes, compared with a polar curve (A) corresponding to the demands set forth in this article.



Cf. "Interavia, Review of World Aviation," Vol. III, No. 3, pp. 166-168.

sinking speed of 0.7 m./sec. lying within a range of 60-70 km./hr. As the flying speed increases, the ideal curve reveals an amelioration of the sinking speed in comparison with the other sailplanes : 1 m./sec. at 90 km./hr. and only 1.8 m./sec. at 120 km./hr. This part of the curve coincides with that pertaining to the WLM-1.

Flight characteristics should correspond to those of a sailplane known to have no unfavourable tendencies.

Safety. Structural strength should allow for acrobatics in order that the aircraft may be used for flying in clouds ; and it appears essential that every acrobatic manoeuvre in soaring (*e. g.* outside looping) should be possible.

Dive brakes must be fitted in order to restrict the end speed and to control the gliding angle during landings.

Unimpeded vision, even towards the rear, is a primary requisite.

In order to obviate damage due to landings, the landing skid must feature sufficient spring travel to cope with an impact velocity of about 1 m./sec., corresponding to the sinking speed at slow flying speed. The extra cost incurred by this will be compensated many times over by the absence of the frequent damage to the fuselage, notably as a result of unforeseen landings on primitive ground during distance flights.

Among general requirements should be mentioned : convenient size and ruggedness on the ground ; simplicity and rapidity of assembly ; ease of maintenance and repair ; good surface protection.

It is no simple matter to find a way towards fulfilling these rigid requirements. Below are a few consideration which may help in this respect.

The price of a sailplane is composed of :

1) a portion independent of the aircraft's size (*e. g.* control parts, or built-in equipment) ; and
2) a portion dependent on the size (and thus weight) and also the design of the aircraft.

We see, therefore, that from the cost standpoint, it is important to keep a sailplane as light as possible, and thus small. Furthermore, however, the light construction must be so conceived that the price drops. Only in the case of sailplanes having to feature extremely high performance has the designer the right to disregard the cost factor and go in for an expensive light construction.

Building light is tantamount to exploiting the materials to the limit of their strength. In sailplanes we find areas which are large in

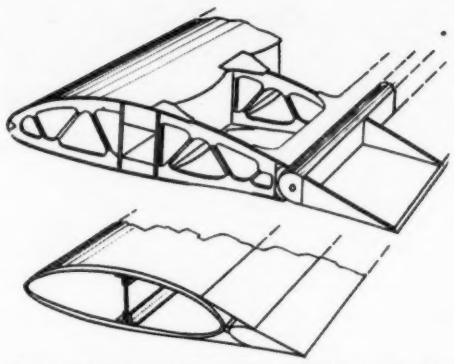


Fig. 2: COMPARISON BETWEEN THE USUAL WING CONSTRUCTION (above) and that suitable for monocoque construction on a production-line basis.

relation to the very small skin gauges used. For this reason the skin over almost the entire surface, whether it concerns the wing or a part of the fuselage, must be reinforced in such a manner that the resistance to buckling is high : buckling resistance signifies better exploitation of material. The reinforcing material, however, as long as it is not simultaneously put to other uses (hinging control surfaces, fittings, etc.), is only exploited to a slight degree. Since small, stressed surfaces with weak reinforcing elements can lead to a saving in weight, there ultimately arises a definite "match-stick" type of construction, which is light but expensive.

If a thicker skin gauge is chosen, however, less reinforcing elements are necessary. Though this entails greater structural weight, it decreases the cost.

The buckling resistance of a given surface is proportional to the quotient of the square of the skin gauge by the modulus of elasticity of the material. As the weight per unit of area augments only linearly with the skin gauge, it is possible to save weight by utilising a constructional material of lower specific gravity, *e. g.* pine or Scots fir plywood instead of beech or birch plywood.

It may therefore be deduced from the above statements that it would be ridiculous to build a light apparatus, such as a sailplane, from a material of comparatively high specific gravity (*e. g.* light alloy).

The weight of the supporting assembly of a normal wing is composed of :

1) the weight of the bending assembly (spar) ;
2) the weight of the torsion assembly (skin) ;
3) the weight of the reinforcing elements (ribs, stringers) ;
4) the weight of the connecting elements.

By conceiving the design so that the duties of the spar, skin and reinforcing elements are largely taken over by a strong skin (monocoque construction), the weight can be stepped down considerably. Such a shell must be resistant to buckling, which means that the skin gauge must be high in proportion to the area.

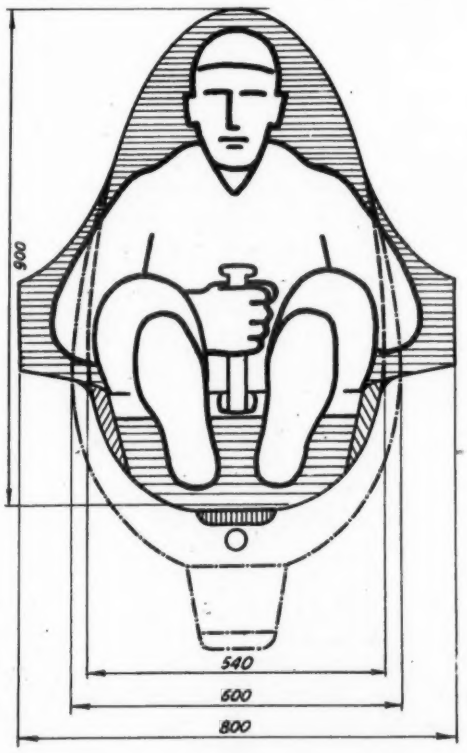
This can be achieved either by using material of low specific gravity, or by chosing the wing form which is best suited to this method of construction. Every design of wing calls for a definite choice and distribution of material ; and conversely, each material indicates a definite design of wing. Studies made in this connection have revealed that it is advantageous to increase the wing loading and aspect ratio.

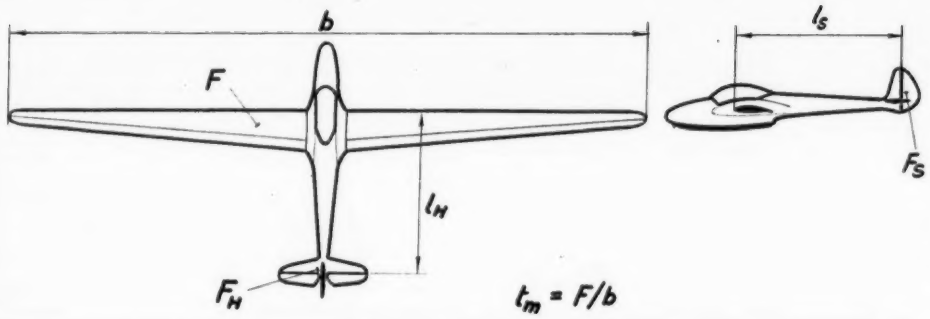
Monocoque construction has the further very great advantage that the buckle-resistant shell makes for greatly superior surface quality and rigidity of form. This is notably a prerequisite if laminar aerofoil sections are to be used.

The structural method used hitherto has the advantage that it enables separate wings to be built with fairly simple equipment, but it nevertheless has the great disadvantage of being totally unsuitable for quantity production on a commercial basis. Compared with the numerous small items of constructional equipment, the fewer, larger devices required for monocoque construction do not present very much greater costs. On the other hand, they pave the way for serial production as a commercial proposition, thereby bringing down the constructional costs.

To return to the flight performance aspects, it is evident that the main contributory factor to good performance is low drag.

Fig. 3: THE CROSS-SECTIONAL FORM OF THE FUSELAGE is responsible for the parasite drag and can be brought to smaller dimensions by a judicious design of fuselage-wing transition.





		F_H/F	$F_H \cdot l_H / F \cdot t_m$	l_H/b	F_S/F	$F_S \cdot l_S / F \cdot b$	l_S/b
1932	Rhönadler	0,148	0,44	0,224	0,070	0,018	0,25
1933	Bussard	0,146	0,45	0,222	0,070	0,018	0,25
1935	Kranich	0,127	0,50	0,28	0,082	0,024	0,29
1938	Reiher	0,138	0,60	0,25	0,098	0,026	0,26
1938	Weihe	0,122	0,60	0,28	0,091	0,027	0,29
1948	WLM 1.....	0,128	0,55	0,31	0,090	0,028	0,315

Fig. 4: **IN THE COURSE OF THE LAST FIFTEEN YEARS** the factors influencing the stability behaviour of sailplanes have been subjected to constant modification.

As regards profile drag, aerofoils should tend towards laminar sections, as these types provide good L/D ratios at high flying speeds. Studies have shown that laminar flow can also be maintained to a great extent with quite highly cambered and relatively thick aerofoil sections. But because in these sections only a small C_L zone features low drag, it is essential that flaps be installed along the entire span. For the sake of convenience, one will begin with a somewhat more cambered basic aerofoil section, deflecting flaps and ailerons upwards for the smallest C_L values, and about 30 per cent. of the deflections upwards and 60 per cent. downwards in the normal zone.

Only for slow flight, in which case it is not so important if the drag rises, does a full downwards deflection occur.

As a result of the small wing chords and sectional sensitivity due to the high aspect ratio, the need for a flexible camber, at least in the vicinity of the flaps (the last 25 per cent. of the chord), returns to the fore. This causes the difficulties of tolerance as regards flap hinging to disappear instantaneously. (Cf. Fig. 2.)

Incidentally, profile camber of this sort also has the effect of damping flutter, which is particularly desirable in connection with high diving speeds.

The installation of dive brakes would mar a large area of an otherwise absolutely perfect surface, since it is invariably difficult to keep to the required tolerances and at the same time provide ease of access. However, this difficulty may be circumvented by installing a parachute in the fuselage rear; and this feature, moreover, provides the following advantages :-

Less weight, no encumbering of any of the reinforcing elements, no detachable connections between the fuselage and moveable surface, and lower costs.

One disadvantage, however, must be mentioned : namely that the wing's resistance to gusts, which is high when the flaps are deflected, suffers.

It has been shown that a monocoque wing structure would allow for greater aspect ratios without very much increase in weight—aspect ratios which are otherwise denied to ordinary sailplanes. The choice of the aspect ratio will therefore depend not so much on achieving the least induced drag, as on limiting the span for other reasons—*e. g.* expense, and bending strength.

The fuselage cross-section, which determines the parasite drag, is shown in Fig. 3 in the smallest possible dimensions that still provide sufficient room for the pilot, without cramping the cockpit space. This diminution of frontal area is achieved by bringing the wing flanges into the cockpit and placing the control cables at the side of the pilot instead of under the seat.

In this way the frontal area can be reduced from about 0.48 to 0.36 sq.m. (5.2 to 3.9 sq. ft.) and the cockpit simultaneously made more comfortable, providing 80 cms. (31.5 ins.) width at elbow level, against the usual 60 cms. (23.5 ins.), with the seat at the same height.

The adoption of a "butterfly" empennage gives rise to a further decrease in drag. Investigation has shown that the sum of the empennage surfaces, which are set at 37 to 40 deg. to the horizontal, becomes at the most only 10 per cent. smaller than in a normal tail assembly, if the stability characteristics are to remain the same.

The butterfly empennage has the following advantages :-

about 10 per cent. less empennage drag ;
less interference drag on the empennage ;
the two parts are lighter and cheaper than the conventional elevators and rudder ;
ground clearance is greater ;
reciprocal disturbance of flow at extreme side-slip angles is eliminated ;
the installation of a rear parachute is facilitated.

Butterfly empennages have already been adapted to quite a number of aircraft, *e. g.* the Beech "Bonanza" personal aircraft, the Bowlus sailplane, and even experimentally to a fighter, the Messerschmitt Me 109. In the latter instance, despite satisfactory results, it was not adopted ; the military authorities complained that damage to one half of the assembly (*e. g.* through shooting) would inevitably entail the total loss of the aircraft.

One objection would be that the superimposing of elevator and rudder control could cause one control to influence the other. Meanwhile, however, a pilot does not fly according to the exact stick or pedal position, but according to the control effect. An example which parallels this is incidentally given by the motorcar, at the time when the steering lever gave way to the steering wheel.

It is clear that every new design calls for a new examination of the stability behaviour. Nevertheless, there are a number of factors upon which the stability depends in first approximation. The table in Fig. 4 shows a group of these determinant factors for a number of well-known sailplanes. It is interesting to note how these factors have changed in the course of development, with the improvements in stability characteristics.

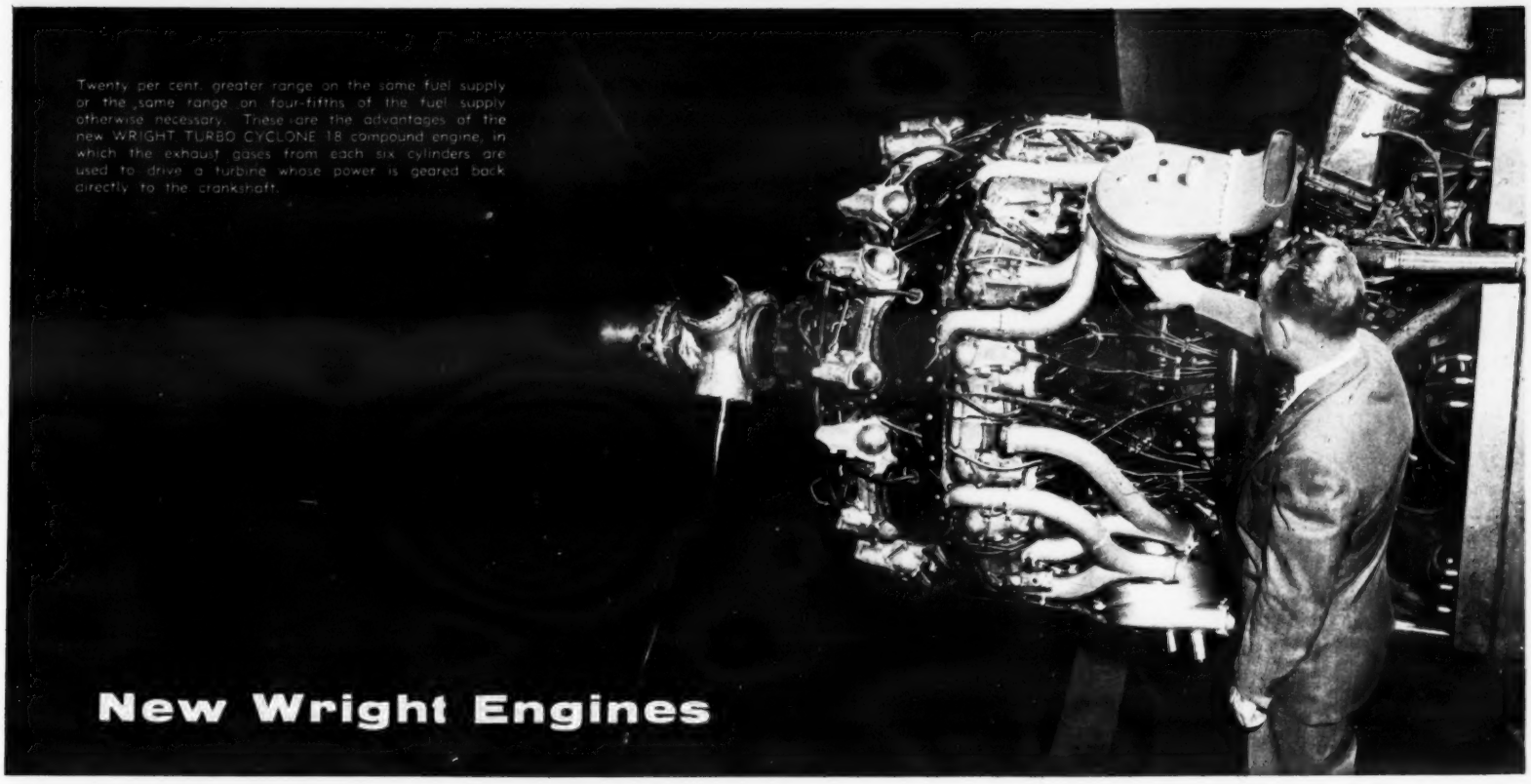
In the above paragraphs, therefore, we have examined the questions of expense, performance, stability and also safety.

General.

The method of construction suggested here calls for no special measures in order to assure adequate ruggedness. Maintenance is simplified because the assembly is much simpler and accessibility is improved by the absence of reinforcements. Good roadability is best achieved by the suggested low weight rather than by installing a wheel. It can of course be necessary to have a wheel for other reasons, for instance for operations from hard surface runways.

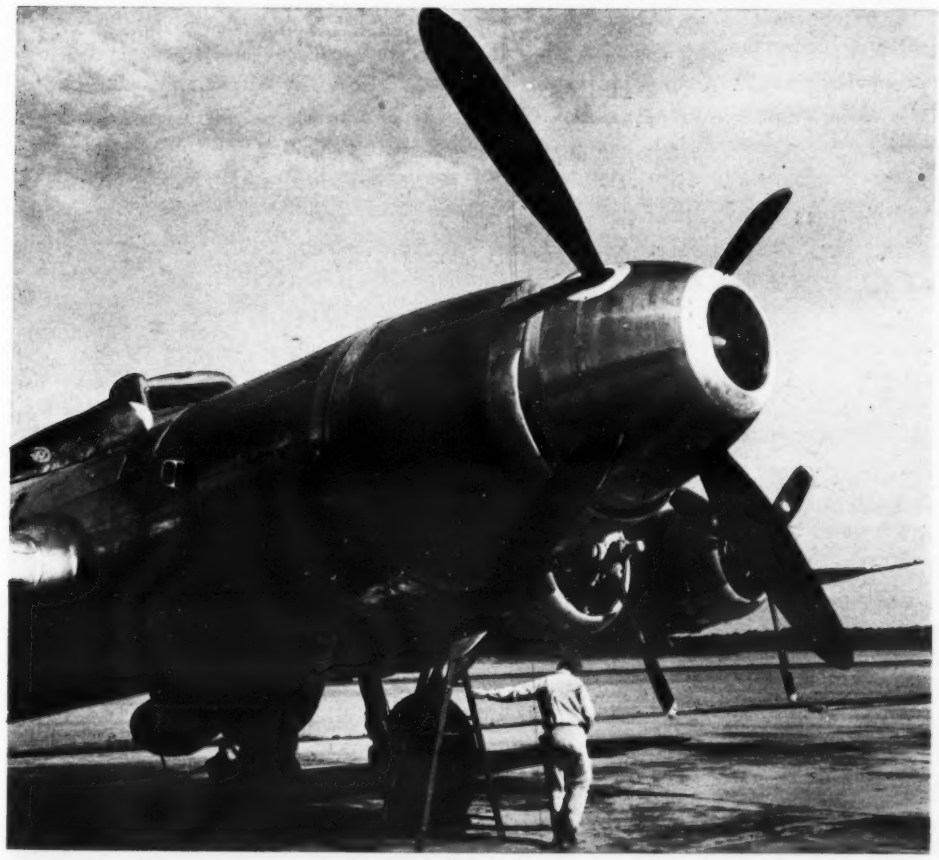
A fabric skin for carrying the dope, a feature now evidenced by quite a number of sailplanes, is to be recommended despite the somewhat higher costs ; the extra expense is easily offset by the fact that less must be spent on interior conservation.

The monocoque wing would present a new vista to the industry, which would not only contribute towards the improvement of sailplane design, but also to the fostering of soaring as a sport.


Twenty per cent. greater range on the same fuel supply or the same range on four-fifths of the fuel supply otherwise necessary. These are the advantages of the new WRIGHT TURBO CYCLONE 18 compound engine, in which the exhaust gases from each six cylinders are used to drive a turbine whose power is geared back directly to the crankshaft.
New Wright Engines

In this fast-moving age, we have become used to thinking, when a new aero engine is mentioned, of a turbo-jet, a rocket engine, or a ram-jet. Even a propeller-turbine does not seem sufficiently interesting to capture our enthusiasm for more than a short while. The high-pressure publicity of the last three years had indeed influenced us into counting securely on concepts of the future and considering as already existent, things not likely to see the light of day for another five or ten years at the least. Our technical era appears reluctant to leave us time to grasp the meaning of what has already been achieved. Why should we play around with achievements which will be surpassed in a very short time. Three thousand horsepower, for instance, is quite a respectable packet of power, but . . . modern man has to move with the times and the newspaper headlines teach him what this signifies.

Showing the XT-35 "TYPHOON" propeller-turbine, driving a CURTISS Electric reversible-pitch propeller, installed experimentally in the nose of a "Flying Fortress." Note the exhaust jet nozzles installed under the fuselage.



It would seem, therefore, that we would be exposing ourselves to complaints from our "modern" readers if we seriously reported in *Interavia* on a new aircraft engine which, as in the good old days, possesses pistons and crankshafts.

However, we can safely assume that the U.S. Navy is not in the habit of spending huge sums on obsolete aero engines. And if Curtiss Wright Corporation, or rather its engine-building division, Wright Aeronautical Corp., received a contract at the end of last September for $32 million worth of piston engines, it proves that the 2,700-H.P. Wright Cyclone 18 twin-row radial is still not yet ready for the scrap-heap.

Meanwhile, a part of this contract concerns an advanced development of the afore-mentioned standard aero engine of the U.S. Air Force : known as the *Wright Turbo-Cyclone 18 Compound Engine,* it combines an ordinary piston engine with three "blow down" or velocity turbines which convert the exhaust gases into power that is geared back directly to the crankshaft. Though at present less value is attached to a considerable power increase in an existing and already very much perfected reciprocating engine, than to a reduction of fuel consumption

The Wright "Typhoon" propeller-turbine, installed in the nose of a "Flying Fortress," furnishes more power than all four normal engines (Wright Cyclones each of 1,200 H.P.).

for the same power, it is worth noting that the new Turbo-Cyclone is claimed to furnish a maximum output of about 3,200 H.P. Rather more important, meanwhile—not only for military operations but especially for various types of modern trans-Atlantic airliner—is to be able to fly the same trip length with a 20 per cent. reduction in fuel consumption. It is obvious what this means for airline operators who sometimes have to leave behind a profitable chunk of payload in order to be able to carry sufficient fuel on board. Nor is it surprising to learn that it has already been decided to power the big Lockheed "Constitution" experimentally with Turbo-Cyclones. Moreover, the Lockheed "Constellation" will also undertake flight tests with the new engine as soon as possible, and therefore be able to register an improvement in payload or range.

What a 20 per cent. improvement in range signifies is clearly exemplified by the Lockheed P2V patrol bomber, the "Truculent Turtle," which set up the world's non-stop record of 11,236 miles over two years ago. Had it been powered with Turbo-Cyclones, it could have flown 20 per cent. farther, or 13,483 miles. Incidentally, production versions of the P2V are to have the new engine, and the fact that the diameter is about the same as that of the old Cyclone model eliminates the necessity of extensive airframe modification for its installation.

Meanwhile, Wright Aeronautical Corp. is also working on more advanced projects. An unknown five-engined aircraft has mystified people on the U.S. East Coast during the past few months. The mystery was removed, however, when it was announced that flight tests were being conducted with a new propeller-turbine, the Wright XT-35 "Typhoon." The accompanying photos, and also the front-cover photo, show this engine installed in the nose of a "Flying Fortress."

The U.S. Air Force, on whose contract the "Typhoon" has been developed, has cast a thick veil of secrecy on the constructional and performance data, so that we can at best resort to estimates. However, we are fairly safe in guessing that its maximum output (shaft power and exhaust thrust) is around 5,500 to 6,000 H.P., thus about five times the power of one of the engines fitted to the "test-bench" aircraft.

The Air Hostess Told Us ...

When in Rome, do as Romans do . . .

An adequate supply of hula dancers, Esmeralda was reading out to us from a serious American trade publication the other day, is again available to welcome all passengers arriving at Honolulu Airport, Oahu, Hawaii, by aircraft of Pan American World Airways and United Air Lines.

Wonderful, says our Favourite Air Hostess, the swaying hips were all that was needed to ensure lasting peace. You no longer think of Hawaii as a formidable air and naval base. Once again it is the peaceful scene of glamour girls, garlands, guitars and grass girdles. Esmeralda believes Hawaii is the answer to many a harassed husband's prayer. How nice it must be to be a Hawaiian—whenever your wife tackles you with her favourite complaint that she has "absolutely nothing to wear," you simply send her out on the front lawn with a scythe.

Applied to international conditions, the hula-skirt idea could be used to bring a little joy into a dreary world. At airports the world over passengers could be welcomed by familiarising them with typically local customs. Few people would mind being received by a crowd of yodlers at Zurich or Geneva, or by a group of Bali Belles at Bali. A cacophony in the form of a jam session at New Orleans would be a novel experience for most of us, and a gipsy band at Budapest would put us into the right mood for gulash and Tokay. A gift of a dozen fresh tulips at Amsterdam or a bottle of old whisky at Prestwick would seem suitable. Madrid would not be so good, on the other hand, with enraged bulls charging around the tarmac, and Chicago would be practically deserted. On the whole, however, the plan seems to be worth submitting to ICAO for immediate and concrete action.

The Revolt of the Animal Kingdom.

Esmeralda says she is growing tired of the Animal Kingdom. She is quite resigned to the fact that aeroplanes are still described as "giant birds" or "gleaming fish" and that junior reporters take a fiendish delight in calling pilots "birdmen." But our furry and feathered friends really have an exaggerated effect on aeronautics.

For instance, there is the problem of the pigs. Pigs you find in every walk of life, of course, and hogs are as common in the sky as on the roads. Usually, however, you try to avoid them, and it therefore seems a little incongruous that some people go out of their way to construct a piggery, complete with allotment, near an airport. Yet, this is about to happen at Croydon Airport under a scheme suggested by porters and crash crews and sponsored by the Airport Commandant. Possibly the latter has hopes that the arrangement will accelerate the turn-around of aircraft by preventing air crews from lingering in the vicinity.

Then there was the case of Percy Prune, the pig-headed prize pig of Rochester Airport, England, who upset the local flying community by going AWOL a few weeks ago. He was persuaded to come back only after a protracted search in which several aircraft and a Wing Commander took part.

Furthermore, when pigs decide to be pigs, they really are pigs, as was clearly demonstrated by a whole tribe of porcine quadrupeds at La Guardia Field, New York, not long ago. A Seaboard & Western Airlines DC-4 was scheduled to take forty-four pigs to Milan, together with a considerable number of other rural inhabitants. When the animals were about to be loaded on the aircraft, they decided to run away in forty-four different directions, accompanied by disagreeable... sounds. This insurrection of the pigs instantly provoked a revolt among the remaining passengers, namely, seven bulls, two heifers two cocker spaniels, two Scotch terriers, an English setter and sixteen Leghorn chickens. It took the entire animal know-how of Mr. W. J. Leibundgut, a sturdy Swiss, to round the creatures up and bring the situation under control.

So much for the farmyard. But, Esmeralda claims, every other animal, fowl or insect seems to be equally opposed to the man-made flying-machine. Take Kella, the black panther whom Air France recently flew from Saigon to Paris. Kella got out of her cage in the cargo hold and penetrated into the baggage compartment. For the greatest part of the flight she concentrated on giving the crew a nightmare, snarling savagely each time the aircraft lurched.

It seems logical, therefore, that man has decided to retaliate by using aircraft against these uncivilized pests. In effect, an enterprising young man from Cincinnati, Herbert W. Lockwood, has founded a company called Airsafari, Inc., which organizes big-game hunting trips to Africa by air. Cost : $5,000 to $7,000 per head for a one-month expedition. Perhaps that will teach the surviving animals to behave in the world of aeronautics.

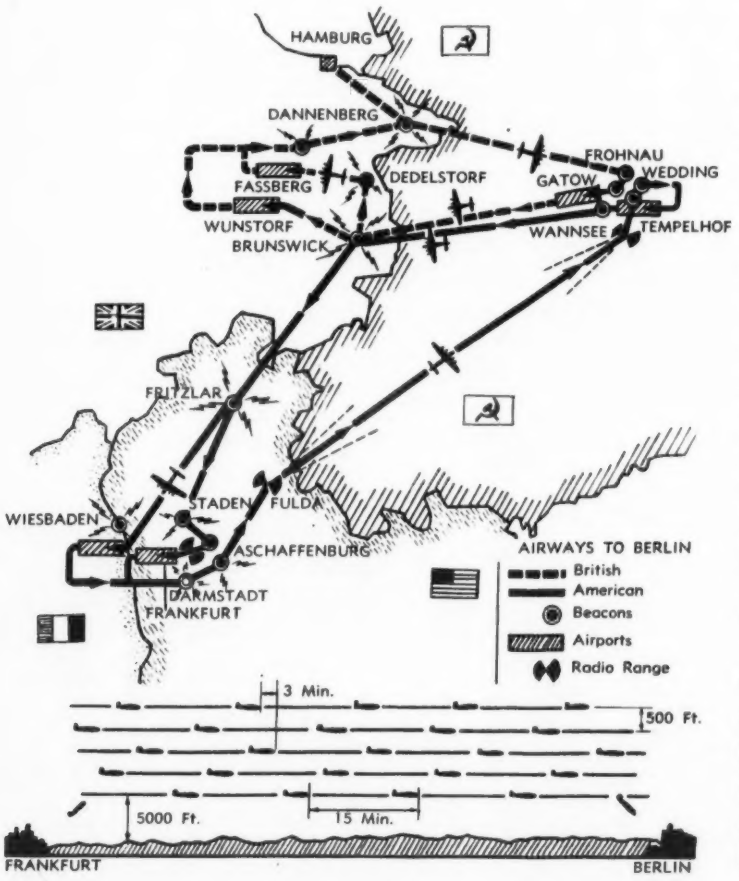
Bl.

The Air-Lift

Since the end of June, 1948, when the American Government was given the choice of keeping its troops in the beseiged city of Berlin by means of a military *tour de force*, regardless of the consequences, or circumventing the Russian blockade in another manner, a non-stop stream of transport aircraft has formed two mighty airways converging on Berlin. Thunder, fog, or nocturnal storms have not succeeded in quelling the roar of engines in these corridors for a single second. Four years ago the hum of aircraft overhead signified death and destruction to the population of the German capital ; today it means that food and fuel will reach the inhabitants of the western sector of Berlin.

What is today being enacted being Frankfurt, Wiesbaden, Wunstorf, Fassberg, Hamburg and Berlin has long since outgrown the experimental or demonstration stage. Viewed politically, the air-lift is a proof of the readiness of the Western air transport fleets and the determination of the Western Allies not to be forced into taking drastic decisions ; but in principle, it is nothing other than a supply operation, since it can do little towards solving the problem of Berlin.

The Americans fly into Berlin from the south-west, from the airports of Frankfurt and Wiesbaden via Darmstadt, Aschaffenburg and Fulda to Tempelhof. Beacons have been erected at these points, which enable the course to be held with extreme precision. A radio range installation south of Berlin, supplemented by two additional beacons, enables the airport to be approached from the east, and crossed.



The second airway to Berlin, north of the city, is flown by the British. They approach from the north-west, from the airports of Wunstorf, Fassberg and Hamburg (the latter is simultaneously a marine base for "Sunderland" flying-boats), reaching Gatow airport via Dannenberg.

A joint airway leads out of Berlin, in a western direction towards the beacon station at Brunswick. From this point the British fly to their bases in the north and the Americans to theirs in the south. The distribution of aids to navigation, the airports and the fundamental organisation of the air-lift is discernible from the accompanying map.

The performance put up by the personnel and the flying equipment is amazing. In Frankfort, for instance, aircraft usually leave at intervals of not more than three minutes. The first of a group of three maintains a minimum altitude of 5,000 feet, whereas as the second flies 500 ft. above it and the third 500 ft. above the second. Though this arrangement does not completely eliminate the danger of aircraft bumping into one another, it nevertheless reduces considerably the possibility of a direct collision. The Frankfort—Berlin flight with the C-54 (cargo version of the Douglas DC-4) takes on the average one hour 40 minutes ; and in many cases the same crew carries out three complete round trips within twenty-four hours. It goes without saying that the aircraft are overloaded in a manner which no civil aviation authority in the world would condone : C-47s (Douglas DC-3s) carry 8,000 lbs. of cargo on each flight, and C-54s 20,000 lbs. Meanwhile, the Berlin air-lift is subject to military regulations and not civilian ones ; and the crews know that they are exposed to the same risks as during military transport operations in wartime. The accident list, which totalled 13 deaths up to the end of October, proves that these risks are not to be underestimated.

The air-lift is a provisional measure, instituted in order to give the Western Allies time to come to a decision on the future of Europe. But provisional measures are quite frequently of long standing. At all events, a training centre for air-lift pilots was opened in the middle of October at Great Falls Air Force Base, U. S. A., which is scheduled to deliver 100 three-man crews a month. It has also been decided to replace the twin-engined C-47s as soon as possible with four-engined C-54s, and the air-lift maintenance base, at present at Oberpfaffenhausen in Bavaria, is to be transferred to Burtonwood, England. Moreover, the accelerated expansion of Tegel airport in the French sector of Berlin, and the transfer of civil aviation operations from Frankfurt to Stuttgart, are hardly to be construed as signs of an early cessation of the air-lift.

The only non-paying beneficiaries of the air-lift so far have been the Berliners. Other participants have had to share in expenses which, conservatively estimated, are very near to £100,000 a day. It would be beside the point to use the statistics on the amount of cargo transported and the number of miles flown, to work out the price of a ton of coal or a tin of condensed milk. Much greater odds are now at stake in Berlin.

Official Bulletin of the

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS

41st General Conference of the F.A.I.

Paris, September 29th to October 1st, 1948.

As announced in the October issue of *Interavia*, the F. A. I. held its 41st General Conference in Paris.

Below are the most important decisions taken on this occasion :

1. The Conference agreed to the admission of the Federation of Australian Aero Clubs, which is allocated one vote.
2. As a result of a secret vote, the Aeronautical Federation of Spain remains a member of the F. A. I. The votes numbered 35 for and 12 against.
3. Russian was admitted as an F. A. I. conference language.
4. It was decided to create an F. A. I. Regional Air Touring Section in Cairo. Mr. Guiguis Awadalla has been asked to draft a report on the organisation of this section, which will be submitted to the F. A. I. General Council, scheduled to meet next Spring.
5. For tackling the various scientific and technical problems constantly confronting the F. A. I. (especially in connection with the homologation of certain records), it was decided to establish a technical sub-committee within the International Commission of Aeronautical Sport. This sub-committee shall be composed of three to five members, who will be known as Official F. A. I. Experts. To begin with, they shall be chosen from French scientific circles and appointed for periods of not less than two years. They shall be succeeded later by scientists from other countries having aero clubs affiliated to the F. A. I.
6. The Conference took note of ICAO's work, in so far as this concerned private and sporting aviation, and decided to pursue and intensify, to as great an extent as possible, its relations with ICAO, with a view to bringing home the F. A. I.'s opinions on all questions of private flying.
7. The Conference decided to keep on the F. A. I. Air Touring Bureau which, established a year ago under the patronage of the Royal Aero Club of Great Britain, has rendered great services to private flyers. The Conference also recommended that all F. A. I.-member aero clubs should establish similar organisations in order to supply their members with all requisite information and to facilitate trips abroad.
8. The Conference examined the report on the initial work accomplished by the new International Scientific and Technical Organisation on Gliding (OSTIV : Organisme Scientifique et Technique de Vol à Voile) and approved an organisational project drafted by the President of OSTIV.
9. Delegates were unanimous in the opinion that the publication of an Official F. A. I. Bulletin should be resumed. The General Secretariat was thereupon charged with taking the requisite steps as soon as possible.
10. Election of the Managing Committee and General Council : The Conference accepted with regret the irrevocable decision of the President of the F. A. I., Lord Brabazon of Tara, M. C., P. C., not to offer himself for election in 1949. In recognition of the services he has rendered the F. A. I. since his election to Presidency in September, 1946, Lord Brabazon of Tara was unanimously appointed Honorary President.

    Mr. William R. Enyart, F.A.I. Vice-President whose candidature was proposed by the National Aeronautic Association of America and upheld by the Aero Club of France, was elected President of the F.A.I. to the great satisfaction of all present.

    The following Vice-Presidents were elected :

    Baron de La Grange (France)
    Mr. Marcel Devaud (Switzerland)
    Colonel Harald Enell (Sweden)
    Mr. C. Kolff (Netherlands)
    General Seifi DüzGören (Turkey)
    General Ch. Sillevaerts (Belgium)
    General Piero Oppizzi (Italy)
    General M. Gromow (U.S.S.R.)
    Mr. Whitney Straight (United Kingdom)
    Comdr. J. J. Ide (U.S.A.)
    Mr. Otukar Svaricek (Czechoslovakia)
    Mr. Vlodzmierz Humen (Poland)

    The Secretary-General, Mr. J. Blériot, and the General Treasurer, Mr. J. Allez, remain in office.

11. *1949 General Conference.*

    Mr. William R. Eynart conveyed an invitation to delegates to hold their 42nd General Conference next year at Cleveland, Ohio, at which time the U.S. National Air Races will be held in that city.

    The Conference cordially thanked its new President for this invitation and accorded the national aero clubs a month's delay in which to convey their formal acceptance and state the number of delegates that would attend.

NEW RECORDS HOMOLOGATED BY THE F.A.I.

INTERNATIONAL RECORDS

Class C — Category 4

(Cylinder capacity less than 2 litres)

Distance in a straight line (France)
Miss Jeanette Poujade
"Stark" A. S. 71 aircraft, No. 14
Walter "Mikron" engine of 1.977 litres cylinder capacity
From Bron Airfield, Lyons, to Sundsvall, Sweden
On September 11th, 1948 : *2,028.588 kms.*

Women's Records

Class C

Speed over 3-km. course (U.S.A.)
Miss Jacqueline Cochran
North American P-51 monoplane
Packard/Rolls-Royce "Merlin" engine of 1,450 H.P.
Coachella Valley, California
On December 17th, 1947 : *663.034 km/hr.*

Book Reviews

Le Vol à Voile. By Raymond Sirretta. "Sports et Tourisme" collection published by Flammarion, Paris, 1948.

Swimming, cycling and canoeing are the subjects already dealt with in Flammarion's "Sports et Tourisme" collection. The series is now continued with a book on gliding and soaring, aiming to foster this activity, too, as a national sport. The author is an experienced practician who has a gift for writing and expressing himself clearly ; a mass of material is arranged in logical order and the essential data are presented in a manner to capture the reader's interest. The result is a book which is bound to popularise this king among sports ; a book which will be appreciated by "experts" and also warmly welcomed by the public.

From the physical and meteorological fundamentals, and a description of the flying equipment, to instructions on blind flying, the reader will find everything worth knowing about gliding and soaring—supplemented by many valuable tips from an experienced soaring pilot. There are 213 pages and 83 illustrations. (French.) *Ri.*

Jane's All the World's Aircraft, 1948. Compiled and edited by Leonard Bridgeman. Published by Sampson Low, Marston & Co., Ltd., London ; The MacMillan Co., New York ; The MacMillan Co. of Canada Ltd., Toronto.

As usual, this well-known annual is divided into four main sections : Military Aviation, Civil Aviation, Aircraft, and Engines. Editorial deadline was August 15th, 1948, and this year's edition is characterised by exceptional completeness. In addition to the very thoroughly described British and U.S. aircraft and aero engines, a large amount of space is devoted to the products of the Russian aeronautical industry. Especially interesting data are given on Soviet jet fighters and bombers.

This year's edition gives details for the first time on rocket power plants—*e. g.* products of Reaction Motors Inc. and Aerojet Engineering Corp. As regards Soviet power plants, the piston engines are to the fore. It is stated that large-scale development work on jet engines is proceeding in the U.S.S.R., and line production has already started, but that the majority of these engines are former German types which are being copied and occasionally improved. *Ba.*

THE MONTH IN REVIEW

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AVIATION POLITICS

● *ICAO:* Burma has become the 50th member of the International Civil Aviation Organisation in Montreal. Spain remains a tacitly accepted ICAO Member State, since her exclusion in 1947 was not voted by the required majority of members and was never ratified. (Of considerable interest is the fact that on the occasion of the UNO Assembly in Paris the delegations of several Western powers advocated an intensified collaboration with Spain. — Ed.) The Legal Committee of the International Civil Aviation Organisation met in London from September 24th to October 1st.

● *The Berlin Air-Lift.* On October 15th Russian artillery formations staged a three-hour practice shoot which interefered with the traffic control system of Gatow, the airport in the British sector of the German ex-capital. Great Britain and the United States decided to merge their military transport organisations operating the Berlin supply line under the designation "Combined Air-Lift Task Force." The U.S. Air Force is claimed to be considering the call-up of 10,000 ex-members of the Luftwaffe and to employ them in the ground services necessitated by the air-lift. Military interference by the Soviet Union is also directed against an air-lift operated in the Far East, where the Chinese Government is supplying cities in Manchuria cut off by Communist rebel troops. The Chinese Government's supply base is at Mukden.

● *Bilateral Civil Air Agreements* have been concluded by the following countries: Great Britain and Egypt on September 21st, Great Britain and Denmark, Bolivia and U.S.A. on September 29th, Holland and Spain on October 5th. Negotiations for civil aviation agreements are pending between India and Iran, the Soviet Union and China, Italy and Spain, South Africa and Switzerland. A provisional agreement has been concluded by South Africa and Egypt.

● Professor Eduard Amstutz resigned his function as Delegate for Civil Aviation of the Swiss Federal Government on September 30th. In the autumn of 1947 Professor Amstutz presided over the ICAO Conference in Geneva.

SAAB-90A1 "Scandia" twin-engined airliner, developed and built by Svenska Aeroplan A.B., Sweden. The cowling to the two Pratt & Whitney R-2000 "Twin Wasp" 1,450-H.P. engines, shown here on the prototype, has been redesigned for the production versions.

FIRST FLIGHTS

● On October 13th the prototype of the *NC 1071 torpedo and dive-bomber* built by SNCA du Centre, the French nationalised aircraft concern, made its first flight. The NC 1071 is powered with two Rolls-Royce "Nene" gas turbine engines built under licence by Hispano-Suiza.

NEW AIRCRAFT

● The *Douglas XF3D-1 "Skyknight"* two-seater jet fighter has started its flying trials. The Douglas Aircraft Co. is preparing a "Skyknight" production line at its El Segundo plant. The XF3D-1, which is designed particularly for night-fighting duties, is reportedly to go into squadron service both with the U.S. Navy and the U.S. Air Force.

Douglas XF3-D1 "Skyknight"

● Piasecki Helicopter Corp., of Morton, Pa., is developing a very large helicopter for the U.S. Air Force, the *Piasecki XH-16*. The design of the XH-16 takes into account experience gathered in the construction of the Piasecki HRP-1 "Rescuer" and Piasecki XHJP-1 helicopters. The XHJP-1, which was built for the Navy and has started its flying trials, may be considered as the prototype of the XH-16; however, the XHJP-1 is considerably smaller than the XH-16.

United Helicopters "Hiller 360"

● The *"Hiller 360" helicopter* developed by United Helicopters Inc. has been awarded an Approved Type Certificate by the Civil Aeronautics Administration. The certificate applies to an open cockpit version; a cabin model is also being built (see October issue). United Helicopters will shortly start production on the open cockpit type.

● The *Mauboussin M. 129/48* and *M. 124* two-seater low-wing monoplanes built by Etablissements Fouga & Cie, of Aire-sur-Adour, France, are being subjected to official type approval tests. The M. 129/48 is powered with a 75-H.P. Minié 4 DA 28 engine, the

Mauboussin M.129/48

M. 124 has a 75-H.P. Salmson 5 AP 01. The M. 129/48 is a development of the pre-war Mauboussin M. 123.

● Aeritalia, the Aircraft Division of Fiat S.A., is about to complete a new basic and fighter trainer aircraft, the *Fiat G. 61*. The type, derived from the Fiat G. 55, is powered with a Rolls-Royce/Packard "Merlin V 1650-7" twelve-cylinder liquid-cooled in-line engine developing 2,000 H.P. for take-off. Span, 38 ft. 10½ in.; wing area, 227.2 sq.ft.; gross weight, 7,940 lbs.; maximum speed, 391 m.p.h. at 20,000 ft.

● The prototype of the *Fokker S. 12* two- to three-seater trainer has reached the final assembly stage at the plant of N.V. Verenigde Nederlandse Vliegtuigfabrieken "Fokker." The S. 12 is basically similar to the S. 11 "Instructor" but features a nose-wheel landing gear. The *Fokker S. 14* is a training aircraft for a crew of two or three. The type is equipped with a Rolls-Royce "Derwent" gas turbine engine.

POWER PLANTS

● The activities of the Allison Engineering Division of General Motors include the development of propeller turbines. The *Allison XT-39* turbo-prop, now being built to a Government specification, is expected to have a total output of about 7,000 H.P.

● The *Cirrus "Bombardier 702"* light aircraft engine built by the Cirrus engine section of the Blackburn Aircraft Ltd. was developed under a contract placed by the Ministry of Supply. Production models are expected to be available at the beginning of 1949. This air-cooled four-cylinder inverted in-line engine does not substantially differ from the well-known range of Cirrus engines. However, the "Bombardier 702" does not work with a carburetor but features direct fuel injection. Each cylinder has an air inlet valve, an outlet valve and a fuel injection nozzle. The "Bombardier 702" is designed for direct airscrew drive and permits the use of tractor or pusher propellers. The engine should normally be used in conjunction with a controllable-pitch constant-speed propeller, but a fixed-pitch type may also be fitted if necessary. Maximum take-off power, 180 H.P. at 2,600 r.p.m. at sea level; maximum continuous power, 162 H.P. at 2,300 r.p.m. at 1,250 ft.

PROPELLERS

● *S.A. de Constructions Aéronautiques Morane-Saulnier* has decided to engage in the production of propellers. The company is putting the final touches to two experimental designs which are intended for the Morane MS 700 twin-engined type, now under construction.

● *Fiat S.A.* has developed a new, hydraulically-operated constant-speed propeller, the *E. 51-1*, which is designed especially for use on multi-engined aeroplanes.

* Excerpts from Nos. 1536—1560 (September 21st to October 23rd, 1948) of "Interavia Air Letter," an aeronautical digest published five times weekly, with photo service, in separate English and French editions.

WIND TUNNELS

● Two new wind tunnels are to be added to the facilities of the *National Aeronautical Research Institute at Amsterdam*. The smaller of the two tunnels will be used for experiments at supersonic speeds, whilst the larger will operate at subsonic velocities.

INDUSTRIAL NEWS

● The Aircraft Industries Association of America visualizes a "*modestly profitable* 1948" for the U.S. aircraft industry. Although the industry reported a peak loss of $115,400,000 (before tax credits) in 1947, large military orders and previous absorption of major losses sustained in the development of commercial transports would enable the industry to end the current year in the black.

● The U.S. Government has ordered *anti-trust proceedings against E.I. Dupont de Nemours & Co.*, the American chemical concern. Whilst the group's substantial interest in General Motors Corp. is well known, the Government is curious to know the financial relations existing between the concern and the following companies : North American Aviation Inc., Bendix Aviation Corp., Ethyl Corp., U.S. Rubber Co., Kinetic Chemicals Inc., and Remington Arms Co.

● Floyd Bostwick Odlum, Chairman of the Board of Directors of Consolidated Vultee Aircraft Corp., has announced the formation of a *special equipment finance subsidiary* which is to lease transport aircraft to commercial airlines and other interests. Unlike earlier projects of the kind, the company will be operated on a private enterprise basis, although Government funds will be solicited to obtain the necessary capitalisation.

● According to George Strauss, British Minister of Supply, the total development cost of the *Bristol "Brabazon I"* eight-engined commercial airliner will be about £12 millions, exceeding the original estimates by more than 40 per cent. The Minister stated that the "Brabazon I" would be ready to fly "very early next year." The first flight was originally scheduled to take place in the spring of 1947.

● The Aviation Division of the Dunlop Rubber Co., Ltd., is planning to open a subsidiary factory in Melbourne, Australia. The majority of the aeronautical products now being manufactured by the parent company in Coventry, England, will later be made in Australia.

● *Two German synthetic gasoline plants* have been authorised to resume production : Gelsenberg, and Union Rheinischer Braunkohlenwerke Wesseling. The combined output of the two plants is to attain 7,000 to 9,000 tons annually, enough to cover the most urgent needs of the British-American Bi-zone.

INDUSTRIAL PERSONALITIES

● *Dr. Theodore von Karman*, professor of aeronautics and director of the Guggenheim Aeronautics Laboratory at the California Institute of Technology and Chairman of the Scientific Advisory Board of the U.S. Air Force, is one of the two recipients of the 1948 Franklin Medal. The honour was awarded him "in recognition of his outstanding engineering and mathematical achievements, particularly those relating to the development of advanced aerodynamic conceptions."

● On October 15th, *Dr. Vannevar Bush* resigned as Chairman of the Research and Development Board of the U.S. National Military Establishment. Dr. Bush, one of America's leading atomic researchers, returns to Washington's Carnegie Institute, which he has headed since 1939. Dr. Bush motivated his resignation by his belief that "rotation of civilian membership in the board will bring new points of view and broaden contact between military and civilian scientists." Dr. Bush has been succeeded by Dr. Karl T. Compton, President of the Massachusetts Institute of Technology, whose appointment was announced on October 6th.

AIR TRANSPORTATION

● *Atlantic :* The peak Atlantic traffic of the second half of September (of a total of 117 weekly schedules, 62 were operated by the three American Atlantic lines, 55 by the six European lines and Canada's T.C.A.) has given way to the seasonal slackness of the winter months. British Overseas Airways Corp. and other companies are reducing their schedules to as low as 50 per cent. of their summer operations. Swissair has suspended its North Atlantic special flights for the winter season.

● On November 1st Pan American World Airways reduced its Atlantic sleeper surcharge from $100 to $25. The Scandinavian Airlines System is following suit, whereas Air France and Trans World Airline maintain the original surcharge, explaining that sleeper accommodation entails additional luxury and food service.

● The first trans-Atlantic private radio teletype system (New York—Frankfurt) has been inaugurated by Pan American Airways. On October 1st P.A.A. also introduced private radio telephone conversations for Atlantic and Pacific passengers. Connections may be made through any receiver station in the world.

● On October 1st Ground Controlled Approach (G.C.A.) was introduced at Shannon airport, Ireland ; tests had been going on for the last six months. The facility is being operated by two experts, whilst installations previously fitted at other aerodromes required a crew of five.

● Following the example of the British "Air Baltic," a branch of the London freight exchange, an air freight exchange has been opened in Paris. Purpose is to increase the economy of the French air freight services by a systematic co-ordination of freight offering and air cargo space. M. Jacques Dervieu is the Chairman of the Paris air freight exchange.

● The steadily increasing intensity of the Allied airlift to Berlin has resulted in dangerous overcrowding of Rhein-Main airport, Frankfurt. It has now been decided to transfer all commercial air services to Echterdingen airport, Stuttgart. In order to accelerate communications between Stuttgart and Frankfurt—the administrative centre of the Anglo-American Bi-zone—the Occupational Authorities propose to open a high-speed rail connection between the two cities.

● According to reports from Germany, the Government of Israel has decided to open an air service between Palestine and Munich. A total of about twenty monthly schedules are to be operated in both directions.

● The Australian Government is giving consideration to an immigration plan providing for the carriage by sea and air of about 40,000 European settlers to Australia. According to Immigration Minister Caldwell, the cost of air transport is only slightly higher than that of surface transport.

ORGANISATIONS

● The Second Meeting of the International Federation of Airline Pilots' Associations took place in Paris from September 20th to 23rd. David L. Behncke, President of the U.S. Airline Pilots' Association, was elected President of I.F.A.P.A.

● The FITAP (Fédération Internationale des Transports Aériens Privés), the international federation of private airline operators, met in Paris on October 29th. A reply was given to certain remarks made by Sir William P. Hildred, Director-General of the International Air Transport Association, on the occasion of IATA's Fourth Annual Meeting. It is admitted that a number of charter airlines have fixed their fares lower than the carriers affiliated to IATA, this being because their overhead expenses are smaller as charter-airline passengers demand a lower standard of luxury. The FITAP has no desire to enter into a tariff war with IATA and is willing to co-operate with all the airline organisations.

SERVICE AVIATION

● The members of the Brussels Pact have established a *Western Europe Commanders-in-Chief Committee*, consisting of two British and two French members. *Chairman* is Field-Marshal Lord Montgomery ; *Air Commander* is Air Chief Marshal Sir James Milne Robb ; *Land Forces Commander* is General de Lattre de Tassigny, and *Flag Officer, Europe*, is Vice-Admiral Jaujard. Headquarters of the Committee is in London. The first meeting took place on October 12th.

● According to a report submitted to Congress by President Truman, the United States has supplied war material valued at $159 million to *Greece and Turkey* in the fiscal year to the end of June, 1948. Turkey alone received $75 million worth of military equipment, chiefly aircraft and spare parts. At the present time there are 410 military instructors in Greece.

● Under the *American aid programme to China*, the Nanking Government is receiving considerable quantities of war material from the United States. In the month of August alone, China received 42 Republic F-47 "Thunderbolt" fighters with full military equipment for $544,500 (original cost : $6,781,541). The Chinese Government has also bought 255 engines for Curtiss C-46 "Commando" and Douglas C-47 "Dakota" transports, for $393,500, representing about 10 per cent. of the original costs.

● The Pacific Fleet of the U.S. Navy has been conducting large-scale exercises off the coast of California. Three large aircraft carriers and 275 carrier-borne aircraft took part in these manoeuvres in which invasion operations were simulated.

NOTICE FROM THE PUBLISHERS :

INTERAVIA-NEW YORK

The address of our new office is :

INTERAVIA,
155 East 44th Street,
Commerce Building,
Room 2903,
New York City.
Telegrams : AVIAINTER.

Enquiries concerning distribution and advertising should be sent to the above address. Mr. **JACK DILLON,** who has been appointed head of our U. S. representation, will be glad to furnish any information required.

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Marginal Notes

Fission in Atomic Organisation

The scenes of international politics are changing as if they were mounted on a revolving stage with the engine racing. The crack-up in the U.N. Security Council and the 28th Russian veto marking the occasion, were enough to place the "fission" of the Commission for Conventional Armaments in the background of the news. On October 26th, 1948, this commission turned down a Russian suggestion of September 25th, which provided for a ban on atomic weapons and a general reduction in armaments by one third. The U.S.S.R. and Poland voted in favour of the proposal, and Belgium, Brazil, China, France, Great Britain and the U.S.A. were against it ; Australia and The Lebanon abstained from voting.

It is not the intention here to examine the sincerity of the Russian proposal. But we are obliged to observe with regret that the methods hitherto applied, have failed to bring atomic energy under the aegis of international law. The energy stored up in the atom seems to defy not only technical means of defence, but organisational counter-measures too.

*

The U.S. Atomic Energy Commission did not remained impervious to these storms. On October 15th, Dr. Vannevar Bush retired as Chairman of the Research and Development Board of the National Military Establishment, and Dr. Karl T. Compton, President of the Massachusetts Institute of Technology, took his place.

Dr. Vannevar Bush is one of the leading U.S. experts on atomic weapons. Together with General Marshall, former Vice-President Henry Wallace, Secretary of War Henry L. Stimson, and Dr. James B. Conant, he was part of the committee established in 1941 by President Roosevelt to clarify the problem of using atomic energy in war. Dr. Compton is also a prominent authority on the military aspects of atomic energy, and served in the war as Chief of the Office of Scientific Research and Development.

Dr. Vannevar Bush's resignation stems from his belief that rotation of civilian membership in the research board will bring new points of view and broaden contact between military and civilian scientists.

*

Recipient of the 1948 Nobel Prize for Physics, the well-known English expert, P.M.S. Blackett, recently published his criticisms of the former British commission and of Anglo-U.S. atom politics as a whole : "Military and Political Consequences of Atomic Energy" (Turnstile Press, London, 1948). Professor Blackett was in a way godfather to the first instance of nuclear fission. A pupil of Lord Rutherford, he was the first to photograph the process of nuclear fission. In his book he advises scientists and laymen to acquaint themselves with the atomic problem before taking steps to solve it. Though his advice seems a little antiquated in our modern era of speed, it perhaps ought to be considered nevertheless.

The Next Fifteen Years

Nowadays we are aware that the development of a new big airliner, up to a point where it is operationally reliable, requires at least five years. Since the U.S. aircraft manufacturing industry, as far as we know, is not working on any new commercial types for the time being, non-American constructors will not have to face any new competition for the next seven to ten years. The signs are that U.S. deliveries will be confined to Boeing "Stratocruisers," Lockheed "Constellations" and Douglas DC-6s, though coupled with certain increases in engine power.

Even American experts are exceptionally cautious when prophesying the advent of their first jet-propelled airliner ; and do not expect to see such aircraft in reasonable numbers before 1963.

And in the meantime ? Is the American industry of the opinion that it would be without point to fill the gap of the next fifteen years with transitional types powered with propeller-turbines ? Is it willing to allow British manufacturers to continue peacefully developing their experimental types, without putting a single competitive product on the market ?

These questions were discussed without the least secrecy last October at the annual meeting of the U.S. Society of Automotive Engineers (SAE) in Los Angeles. The airline companies, who have always constituted the driving power behind the development of new airliners, took a passive attitude to the whole affair. Their precarious financial situation and the uncertainty attached to traffic development of the immediate future, forbade their representatives to spur the industry into developing jet-propelled commercial transports.

Industrial spokesmen, among them Clarence L. Johnson of Lockheed Aircraft Corp., were of the opinion that the U.S.A. could build by 1955 a four-engined airliner capable of accommodating 50-100 passengers, cruising at 400 m.p.h. and having a range of 3,500 miles. Noteworthy is that the prime mover suggested for such an aircraft is not the propeller-turbine but the turbo-jet engine. The reason ? By combining a gas turbine with a propeller, one loses the salient advantages of the former—low specific weight, simplicity, lack of vibration and noise, etc.—and the fuel consumption problem of the turbo-jet will, according to the U.S. experts, be solved within the next decade.

Regarding the possibility of putting pure jet airliners into scheduled airline service, the SAE came to the same conclusions as Sir Frank Whittle who stated in the middle of last September in Brussels that this would have to await improvements in airway and airport traffic control procedures. The American R.T.C.A. programme,[1] slated to provide a fully automatised air traffic control and navigational system within fifteen years, should be ready at about the same time as the American introduction of jet airline services.

In the meantime, the old reciprocating engine should give civil aviation, not increased power, but the thing it needs most and has awaited in vain for decades : reduced specific fuel consumption.

[1] Cf. "Interavia, Review of World, Aviation," Vol. III, No. 7, p. 366.

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